MECHANICAL ENGINEERING

May, 1958

Management and Engineering in the Age of Automation

Testing the Oil Industry's Meters

Designing for Safety

Adventure in Science

A Research Sawmill

Sharpen the Truth

Cooling Towers

Flow of Coal

ASME SEMI-ANNUAL MEETING
Detroit, Mich. June 15-19

"Digitape" Electronic Controls

Steam Supply by B&W

CUTS GREENLEE'S FUEL BILL BY 14%

Rockford Plant Saves Money Despite Coal Costs Rise

In its Rockford, Ill., plant, Greenlee Bros. & Company, one of America's largest machine tool manufacturers, needs a lot of steam. Heating, processing, testing and other functions make big demands on boilers — fired with coal that's gone *up* in price.

Greenlee keeps overhead down by keeping steam generating costs to a minimum — with two dependable, economical B&W Integral-Furnace Boilers. Equipped with B&W Jet Ignition Stokers, these modern units started saving money from the day they were installed.

How do you use steam? Whether you use it for processing, for heating or for power, steam costs play a big part in your production budget. A look at your books will show you you're burning a lot of money—every year. And that's the cost that counts —not the initial cost of the boiler.

Most boilers consume their first cost every year, in fuel. For many boilers, the fuel bill will add up to several million dollars during their normal life expectancy. Efficiency can drop 2 or 3 per cent, or even more, and when this happens, a substantial sum of money literally "goes up the stack." Sound engineering, proper maintenance and servicing can prevent this — turning potential losses into actual savings.

That's why you save on steam costs with a B&W boiler. Long-range sustained economy is the natural result of B&W's top-level engineering and consistent high performance. A national network of plants and engineers — supported by more than a century of steam generating experience — is at your service. Talk over your steam needs with B&W, anytime.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-836-1B

BABCOCK & WILCOX

BOILER DIVISION

MODERN STEAM MAKES YOUR PRODUCT BETTER AT LOWER COST

ND FACTS

This big idea really gets around!

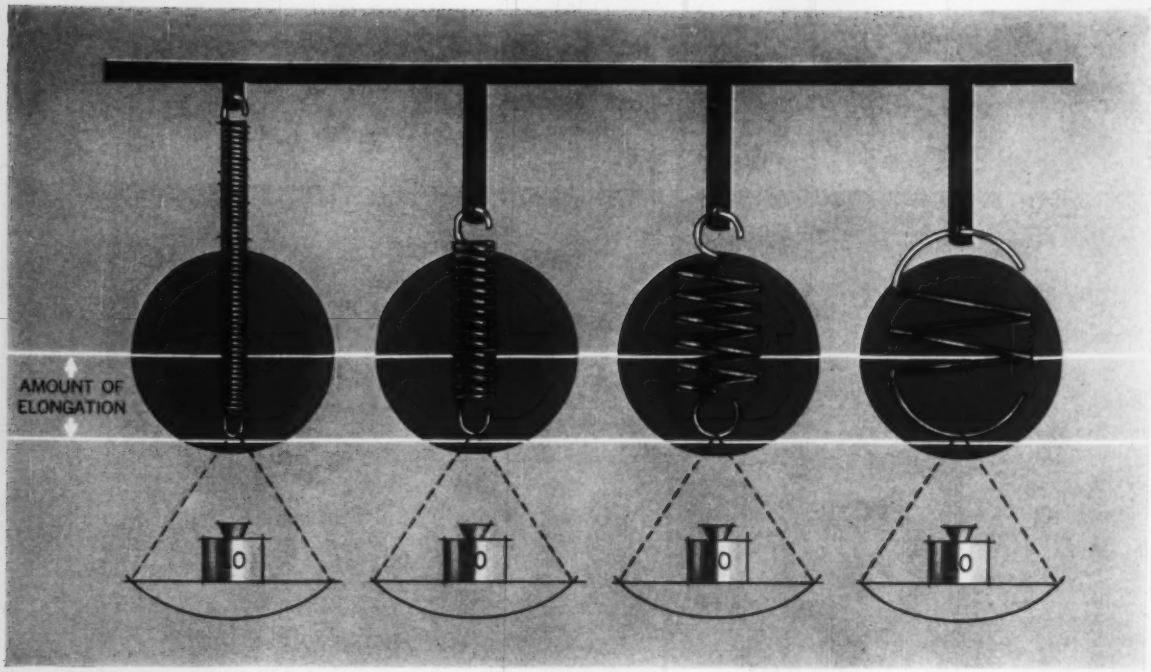
Good ideas get a lot of "mileage"! Take this special automotive bearing pioneered by New Departure. Its unique advantages have been proved by billions of miles in millions of cars and trucks. But "miles-in-use" doesn't begin to tell the story of fan and water pump shaft ball bearing. For design engineers in other fields were quick to spot this bearing's versatility.

So today this New Departure sealed and lubricated-for-life bearing with integral shaft eliminates bearing upkeep costs and simplifies design in a wide variety of familiar products—from home appliances to industrial tools.

If you need help with a big design idea, call or write for consultation with a New Departure ball bearing application engineer.

1908–1958
GM
FORWARD FROM FIFTY

ND NEW DEPARTURE
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.
NOTHING ROLLS LIKE A BALL



Spring shape and performance— or what does Spring Index mean?

One man distributes his 150 lbs. over a lean 6 ft. frame; another packs the same avoirdupois within a stocky 5 ft. 6 in. height. In a man, this might be expressed as the ratio of height to belt size. In a spring, it's a handy little ratio D/d, that of mean coil diameter to wire diameter. The illustration shows it quickly—same load—10 lbs.; same deflection—0.4 in. But in shape they range from the long thin spring at left with 75.8 coils and a spring index of 3, to the short fat spring at right with few coils and an index of 12. Application of the index ratio is particularly useful where space restrictions exist.

Our long years of specialization have developed many short cuts to spring specification to make your work easier. For general reference purposes write for pamphlet "Spring Design and Selection in Brief."

Associated Spring Corporation

General Offices: Bristol, Connecticut

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THE COVER

Blueprint, to tape, to finished part. R. M. Russell of Hughes Aircraft explains "all electronically controlled line of machine tools." Designs are translated into reels of Digitape which control machines by transistorized digital computers. See "The Roundup."

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In the face of the calculated lie, our record cannot speak for itself. Vice-President Nixon calls on us to wage peace, to make the truth heard, and to keep science free to serve peace.

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The petroleum industry must "prove" the meters that measure the flow of its volatile liquids. It's not easy. This is a report on error-producing factors, and methods that achieve accuracy.

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How much power will your sawmill need for your species of log, and for your operating conditions? The answer will come from data of four research mills, like the one at Syracuse University.

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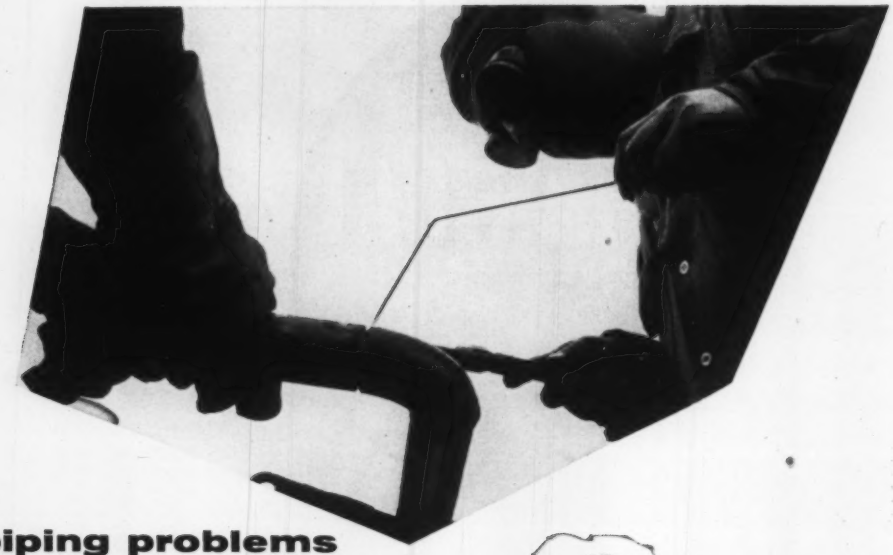

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B&W Welding Fittings, Flanges and Pipe are manufactured in the intermediate chromium-molybdenum alloys and stainless steels (B&W CROLOYS) in a wide range of sizes. They are available through B&W District Sales Offices and any qualified distributor. Write for Bulletin FB503.

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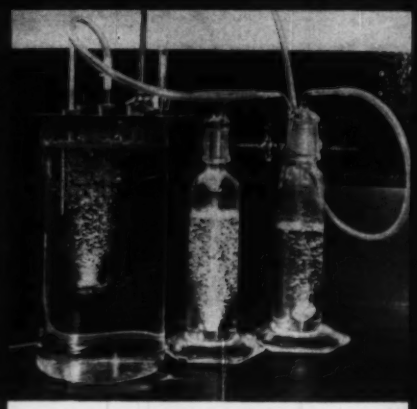

2 Steam condensate corrosion test

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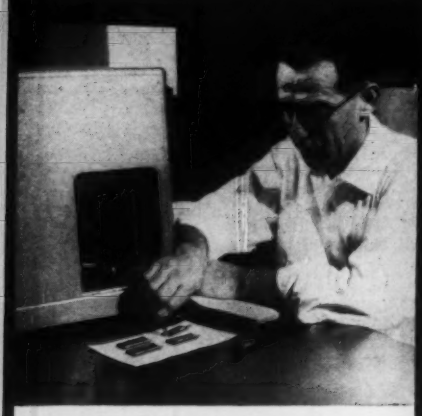

4 Second analytical weighing to determine corrosion weight loss

5 Calculation and statistical analysis of laboratory test results

6 Final examination of specimens under low power magnification

Extensive testing program proves new 4-D Wrought Iron more corrosion-resistant than ferrous substitutes

Test results from the Byers Research Laboratory lend documentary support to the superiority of new 4-D Wrought Iron—over standard Wrought Iron as well as ferrous substitutes.

Convincing case-history service records are now further substantiated by the conclusive findings of our metallurgical staff. Some typical results of this testing program are presented in the chart at right.

The Byers field service representative will be pleased to relate these test results to your corrosive applications. Write us for helpful literature on new 4-D Wrought Iron. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

BYERS WROUGHT IRON

Comparative Analysis of 4-D Wrought Iron Corrosion Tests

Tests	4-D Wrought Iron	Standard Wrought Iron	Ferrous Substitutes
Severe industrial atmospheric continued exposure 17 years	Corrosion weight loss 540 grams/sq. ft.	Corrosion weight loss 655 grams/sq. ft.	Not included in test
Steam condensate return line	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 10 years (still in service)	Complete failure after 2 years
Aerated salt water—5 weeks (Short term test—points indicate 4-D Wrought Iron curve flattening out at much lower rate of attack)	Corrosion weight loss 146 mg/sq. in.	Corrosion weight loss 170 mg/sq. in.	Corrosion wt. loss 226 mg/sq. in.
Brine piping	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 23 years (still in service)	Complete failure after 7 years
Salt water, Gulf of Mexico ¼ inch plate—17 years	Corrosion weight loss 4 mills/years (minimum plate thickness now 3/16") Still in excellent condition	Not included in test	Corrosion weight loss 30 mills/years; plate badly pitted, perforated
Downspout	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures in 29 years (Still in service)	Complete failure after 18 years

*In this application no long term test data yet available on 4-D Wrought Iron. Results shown are derived from short term tests.

only 5% INPUT POWER... dissipated as heat at 90 to 1 reduction

Philadelphia Spiral Bevel SPEED REDUCER

high efficiency...in a right angle reducer

The high efficiency of Philadelphia Spiral-Bevel Reducers has resulted in their use for many speed reduction applications in a wide range of industries. In fact, Spiral-Bevel Units can provide ratios as low as 1 to 1, or as high as 238 to 1, making them applicable to many services where other reducer types are impractical. Another point, these units do not normally require the extra expense of a "cooling-system" to keep the operating temperatures within safe limits.

The combination of cut curved tooth Spiral-Bevel gears with accurately hobbed and shaved Helical gears assures highly efficient operation and long, trouble-free service life.

Philadelphia Spiral-Bevel Units are available in: Single, Double and Triple gear reductions in both *Horizontal* and *Vertical* types, for most every desired horsepower and ratio—they are truly *Highest Quality* Reducers in every respect.

Write for new catalog SB-57 which fully describes these modern gear units.

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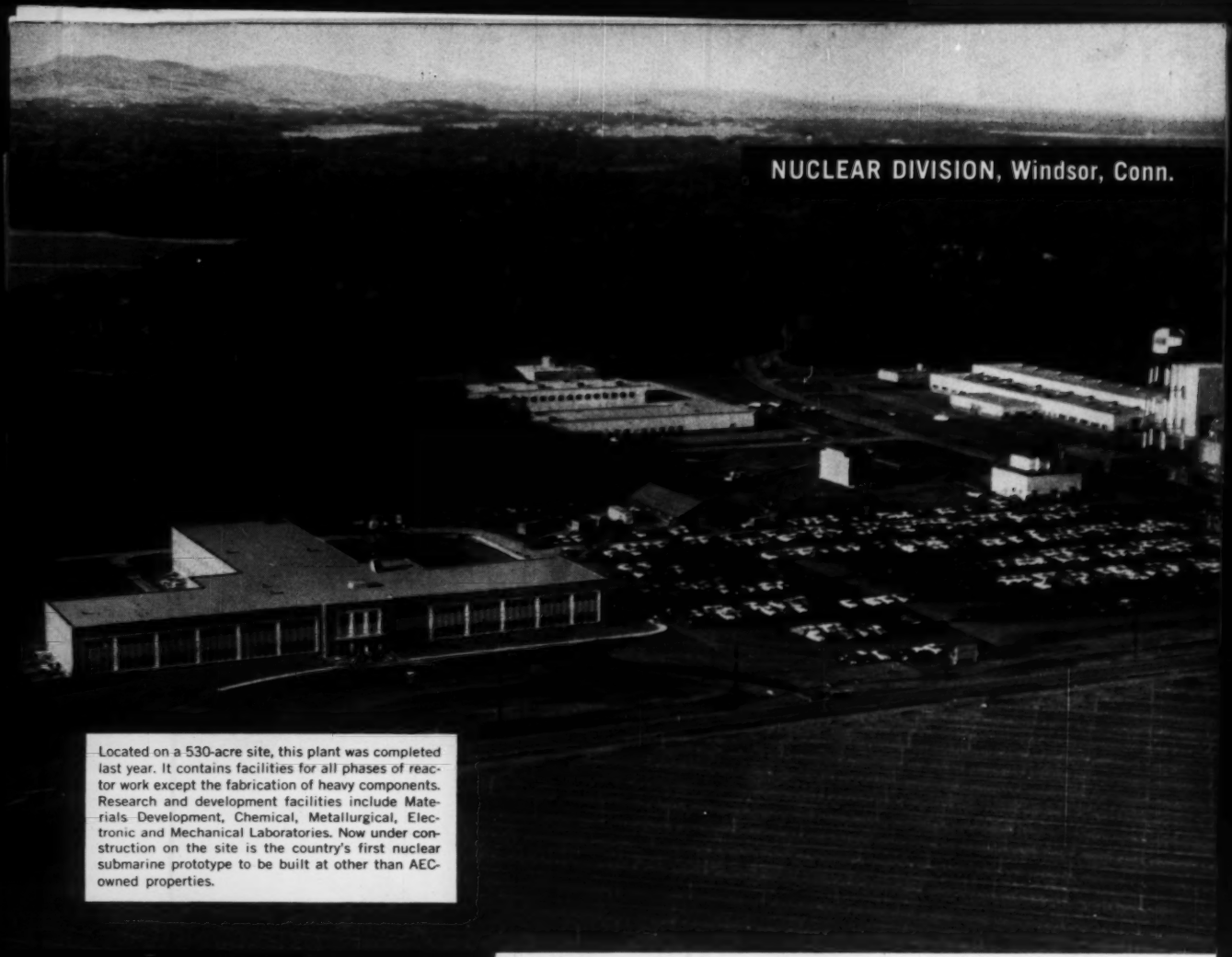


Located on a 530-acre site, this plant was completed last year. It contains facilities for all phases of reactor work except the fabrication of heavy components. Research and development facilities include Materials Development, Chemical, Metallurgical, Electronic and Mechanical Laboratories. Now under construction on the site is the country's first nuclear submarine prototype to be built at other than AEC-owned properties.

(ABOVE)—Partial view of Fuel Element Manufacturing Plant at Windsor. This plant includes an 80-foot high building where the intricate job of reactor core assembly is performed.

(BELOW)—Preparing a reactor for test in one of Windsor's two Critical Assembly buildings. Facilities for reactor testing include equipment for chemical analyses, spectrography, spectrometry, destructive and non-destructive tests.

Ready FOR

On these pages are shown Combustion's facilities for the design, development, manufacture and test of complete nuclear reactor systems, including both light and heavy components. . . . These facilities, fully staffed by scientists and technicians, enable the Company to design and manufacture full-scale nuclear power installations for any requirements—civilian

COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

This 520-foot building contains the specially designed equipment required for the manufacture of heavy nuclear components. Extremely close tolerances, fine finishes and surgical cleanliness are requisites in the production of these massive vessels. The reactor vessel for the Shippingport Station of Duquesne Light Company—the country's first full-scale nuclear power plant—was constructed in this building.

THE ATOMIC AGE

or military. . . . Combustion is also equipped and qualified to serve the nuclear field in the development of Materials, Mechanisms and Processes, and to provide such special services as Safety Consulting, Radiation Surveys, and Chemical and Biological Analyses. Information on these special services is available and will be sent on request.

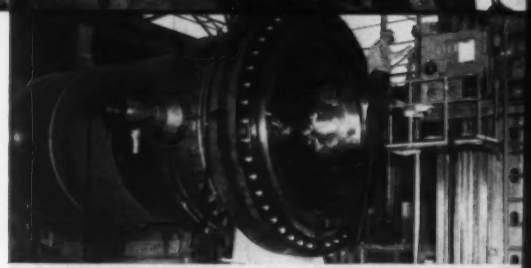
C-153

ENGINEERING

C-E

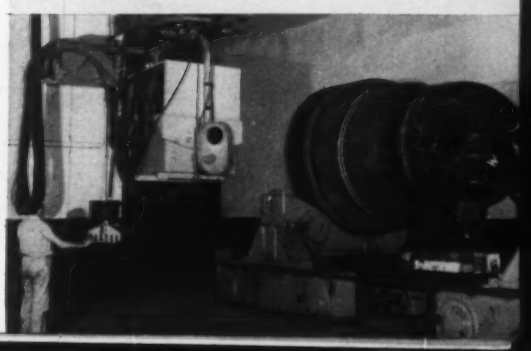
200 Madison Avenue, New York 16, N. Y.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



(ABOVE)—Reactor vessel being machined on large horizontal boring mill at Chattanooga. Other specially designed equipment for heavy component fabrication includes cladders, submerged arc and pressure welders, and optical alignment devices.

(BELOW)—15-million volt Betatron X-raying reactor vessel welds. Other Chattanooga testing facilities include equipment for ultrasonic and metallographic examination.



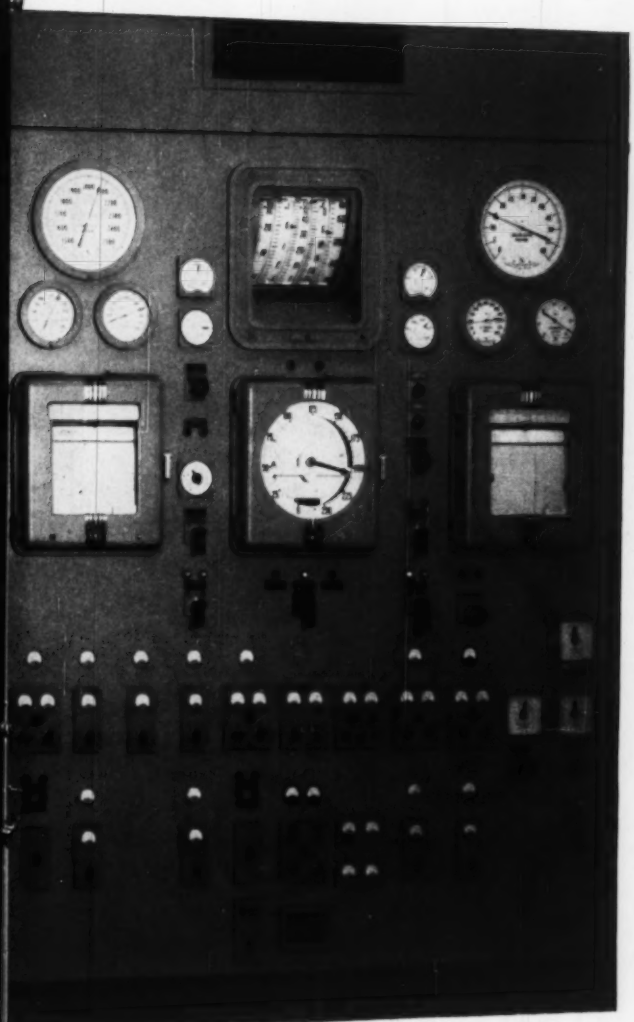
ANOTHER REPUBLIC ACHIEVEMENT!

Electronic Master Systems

. . . at Ohio Valley

Control Five 1,400,000 lb/hr. Boilers

Electric Corporation's Kyger Creek Power Plant



One of Kyger Creek's five Republic control centers. An Electronic Master operates to provide electric signals for pneumatic power positioners on 7 coal pulverizers, 2 F. D. fans and 2 I. D. fans on each boiler.

Five large boilers in this plant produce a million kilowatts for our nation's atomic energy program. Multiple components on each boiler must work simultaneously as a single unit, in order to operate at maximum efficiency under all loads. A Republic *load-sensing* combustion control system with an Electronic Master regulates all these inter-related functions . . . counters every fluctuation in steam flow with corrected fuel and air flow settings without waiting for variations in steam pressure. An integral *pressure* control system makes final corrections in control signals (if necessary) to hold steam pressure constant.

Republic's experience with plants of all sizes, all pressure and temperature ratings, and all load characteristics is your best guarantee of getting all the premium performance built into your major equipment. A technically-trained, thoroughly experienced Republic Sales Engineer is ready to discuss your instrument and control problems. Republic sales offices are located in principal cities throughout the country.

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FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

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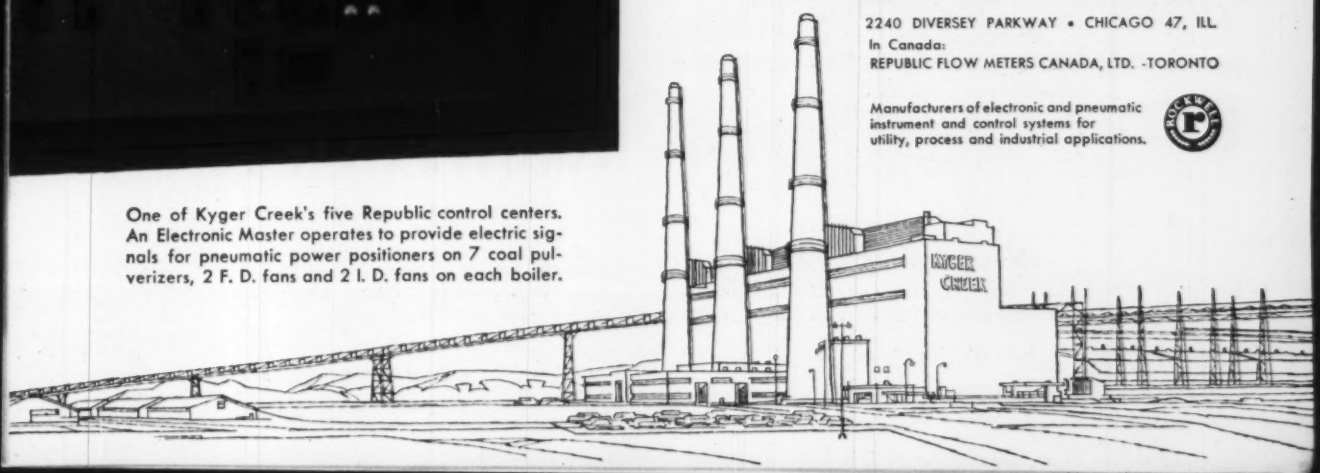
Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.



IMPROVED BLOWER NOZZLE and

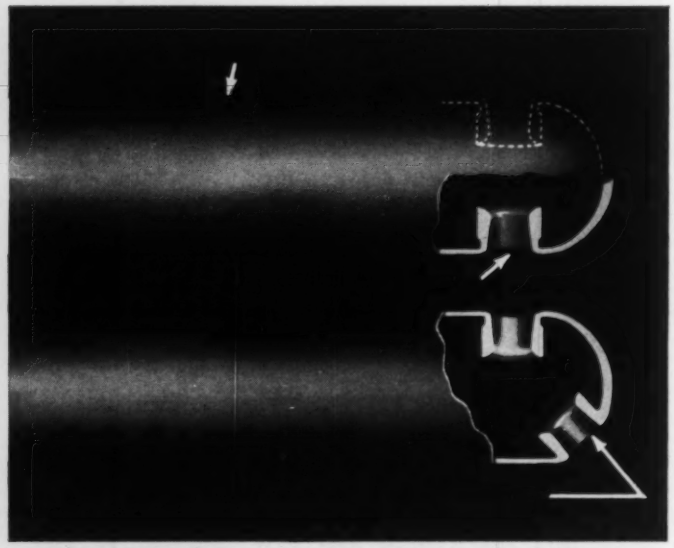
more important features of the

New Diamond Series 300 IK
LONG RETRACTING BLOWER

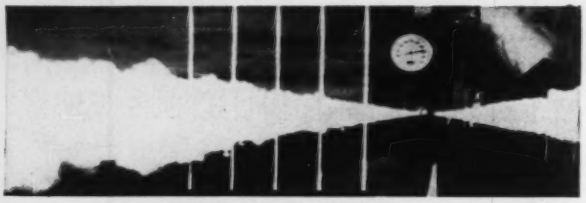
This improved nozzle provides more available cleaning energy per pound of steam or compressed air. A modified venturi, it is the result of extensive research during which more than 50 contours were tested.

The positively-controlled, close helical cleaning pattern assures optimum coverage of the heating surface. Return travel path is exactly intermediate to forward travel path . . . resulting in a positive nozzle sweep every inch.

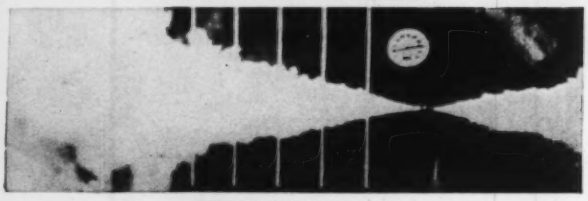
These features are two of many reasons why the Diamond Series 300 IK Blower does a better and more economical job of cleaning surfaces which require a long retracting blower. Other advantages are listed at the bottom of the opposite page. Ask the nearest Diamond office for Bulletin 2111AA which will tell you much more about the new Series 300 IK.



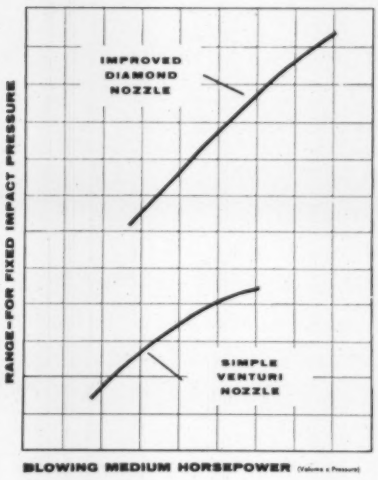
Improved Diamond Type "A" Nozzle has low approach velocity for optimum nozzle performance (see curves below). It provides greatest impact for any given blowing pressure . . . means greater effectiveness and economy.



IMPROVED DIAMOND NOZZLE

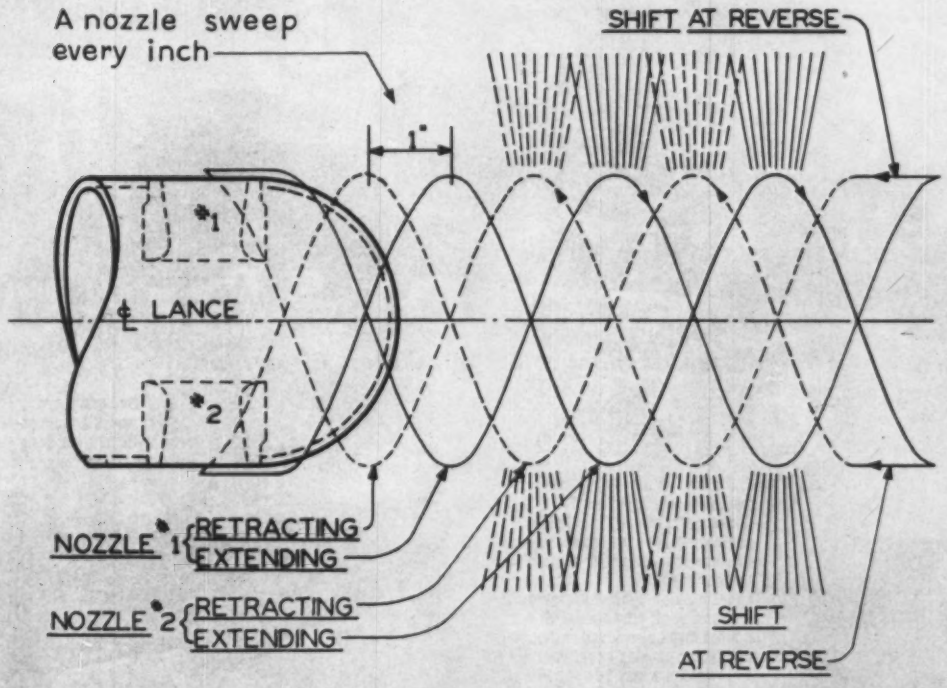


7818 SIMPLE VENTURI NOZZLE


IMPROVED DIAMOND NOZZLE
SIMPLE VENTURI NOZZLE
RANGE—FOR FIXED IMPACT PRESSURE
BLOWING MEDIUM HORSEPOWER (Volume x Pressure)

Note the greater blowing range of the improved Diamond Nozzle when compared with a simple venturi nozzle under identical test conditions.

IMPROVED CLEANING PATTERN



Nozzle-sweep-every-inch blowing pattern assures COMPLETE coverage of ALL surface EVERY time

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited

Windsor, Ontario

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Front End Single-Motor Drive
- Compact, Accessible Electric Power and Control Terminal Facilities
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

Unique packing retention method eliminates test rings

simplifies inspection and servicing reduces maintenance time

Paracoil

TYPE "PC" EXCHANGER

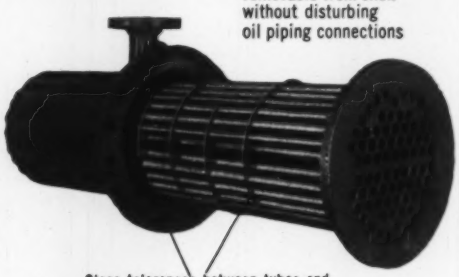
Straight-tube exchanger for oil, water, air or gas

Exclusive "retainer ring" design, available only in Paracoil "PC" Exchangers, **permits shell side pressure test with bonnet removed. No auxiliary equipment or special devices are required to hold tube sheet packing against pressure.** By backing off only one set of nuts, bonnet may be removed without displacing packing or retainer ring. Pressure may be applied to shell side to test for defective tubes or leaking tube joints. With bonnet off, retention studs hold retainer ring and packing in place.

Leak detection holes in retainer ring show leakage from either tube or shell sides (See detail below).

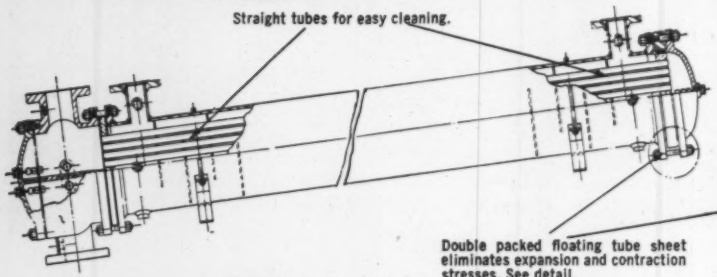
Tubes may be tested, re-rolled, even replaced, without removing tube bundle from shell.

Tube bundle easily removable from shell without disturbing oil piping connections



Close tolerances between tubes and tube holes in baffles, and between baffle periphery and shell, assure maximum heat transfer.

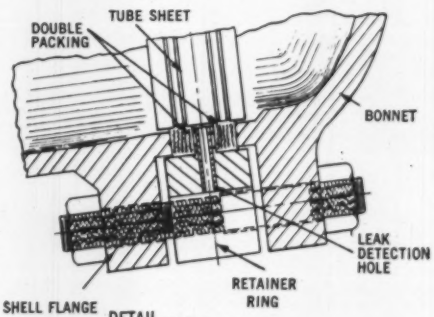
Straight tubes for easy cleaning.



Wide selection of materials as dictated by service requirements.

Double packed floating tube sheet eliminates expansion and contraction stresses. See detail.

Standard commercial, ASME or Marine Code construction.



DETAIL — *Section thru floating tube sheet, showing packing and detection hole in retainer ring.*

HOW IT WORKS

Mixing of shell and tube side fluids due to packing failure is impossible in this Paracoil Type "PC" design. Any leakage from either side, resulting from loosening of bolts or worn packing, escapes through the detection holes. The operating personnel is thus on notice that servicing is required.

Paracoil
HEAT TRANSFER EQUIPMENT

Write for descriptive Bulletin 140

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DAVIS ENGINEERING CORPORATION

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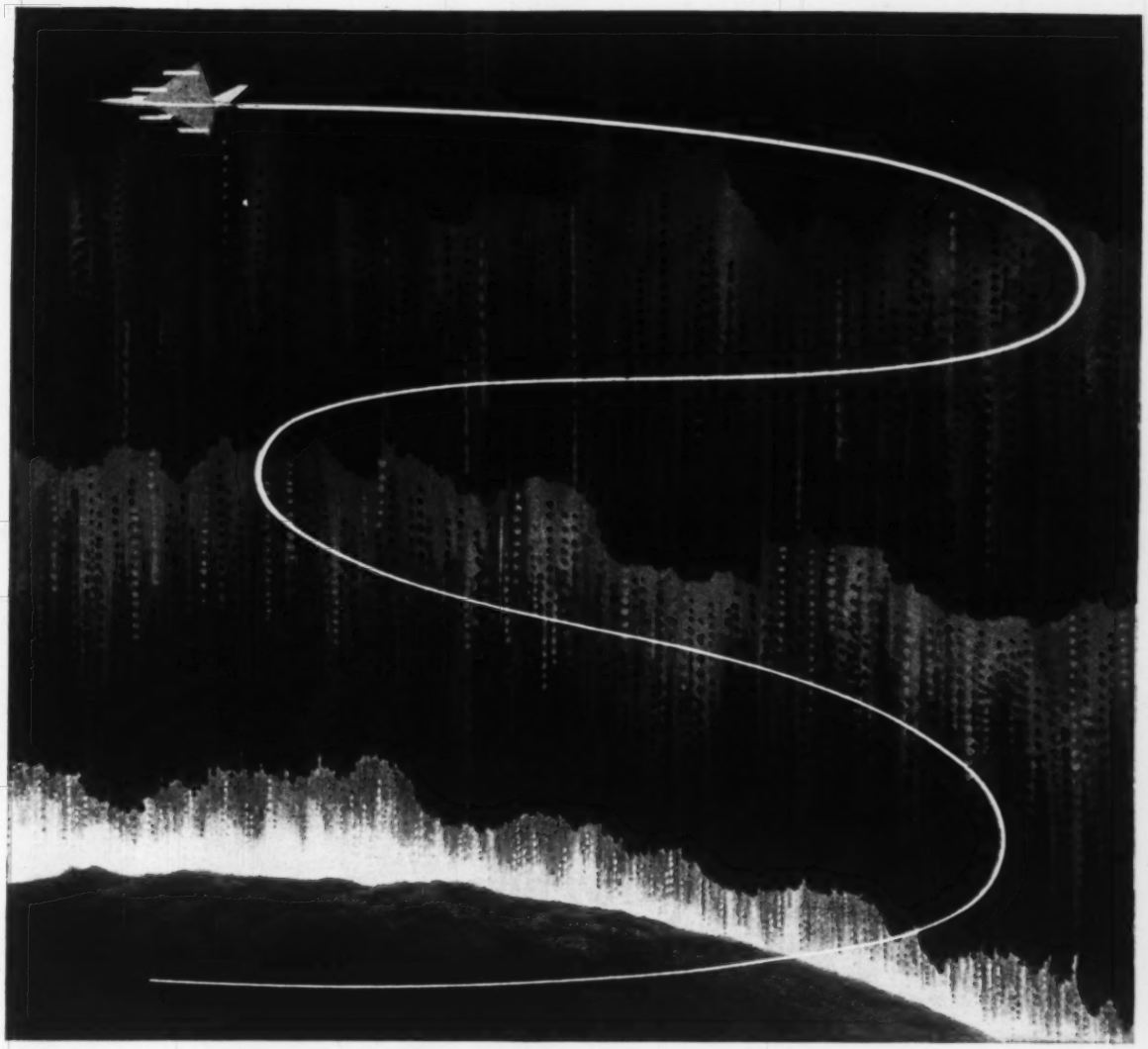

New extreme-high-temperature lubricants for missiles and supersonic aircraft **SHELL ETR GREASES**

One of the serious lubricating problems faced by designers of missiles and supersonic aircraft has been solved by scientists at Shell Research Laboratories.

The problem: to find a grease which would permit components to operate with certainty under extreme high temperatures. Co-operation with representatives of bearing manufacturers and military personnel resulted in a completely new class of greases—SHELL ETR GREASES.

These greases can easily withstand temperatures up to 600°F. They give superior lubricating performance because of a special thickener—an organic vat dye—which has exceptional heat stability and jelling efficiency.

If you are presently in the market for an ultra-high-temperature-range grease, we will be glad to provide more information on Shell ETR Greases.

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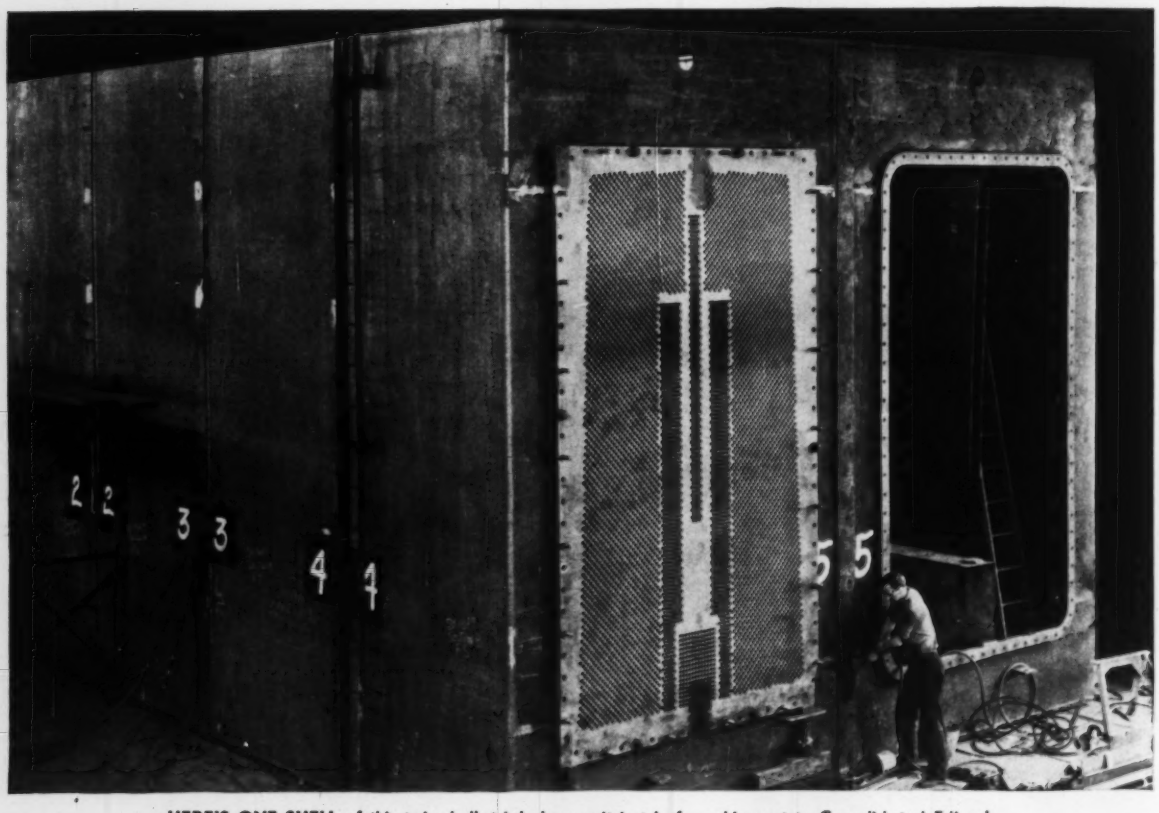
SHELL

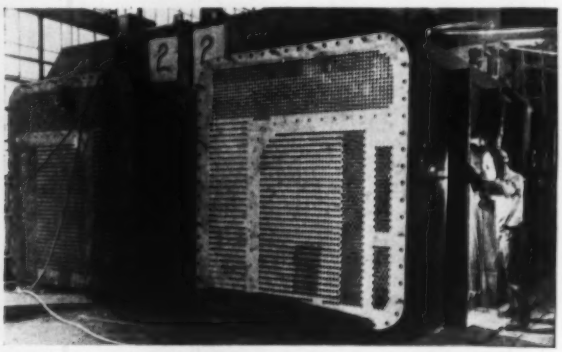


HERE'S ONE SHELL of this twin-shell, triple-lane unit just before shipment to Consolidated Edison's Astoria Station. It's designed to condense 1,600,000 lbs. steam/hr. at 1.87" Hg., with 244,000 gpm circulating water, and has 27,450 aluminum-brass tubes. Unit serves 335,000 kw turbine.

HUGE, SINGLE-PASS, 187,000 sq. ft. CONDENSER

... designed and built by C. H. Wheeler is now being installed at world's largest metropolitan utility

VICE-PRESIDENTS LEE YETTER and Roy Droescher, and Chief Engineer Paul Hamm are responsible for the design and construction of all Wheeler condensers. They work with engineers employed by C. H. Wheeler's customers, with turbine manufacturers' engineers and consulting engineers in BTU chasing.



TYPICAL REVERSE FLOW CONDENSER is this 35,000 sq. ft. unit for a Southern electric utility. Patented Reverse Flow feature permits flushing debris from tubes with only slight (and momentary) vacuum loss. Note low height to save head room, rectangular cross section to further utilize space for this Wheeler client.

C. H. Wheeler Mfg. Co.

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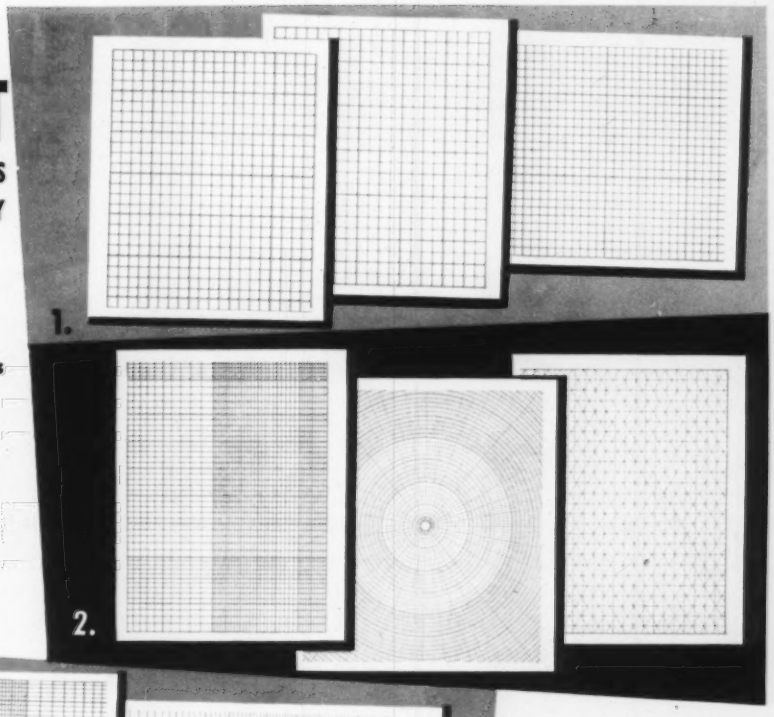

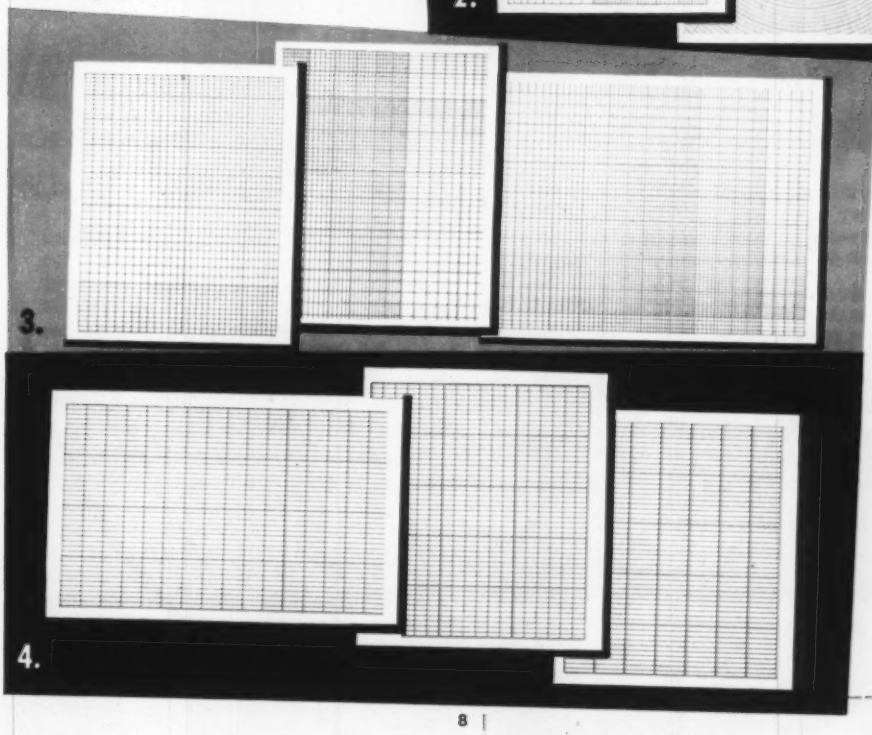

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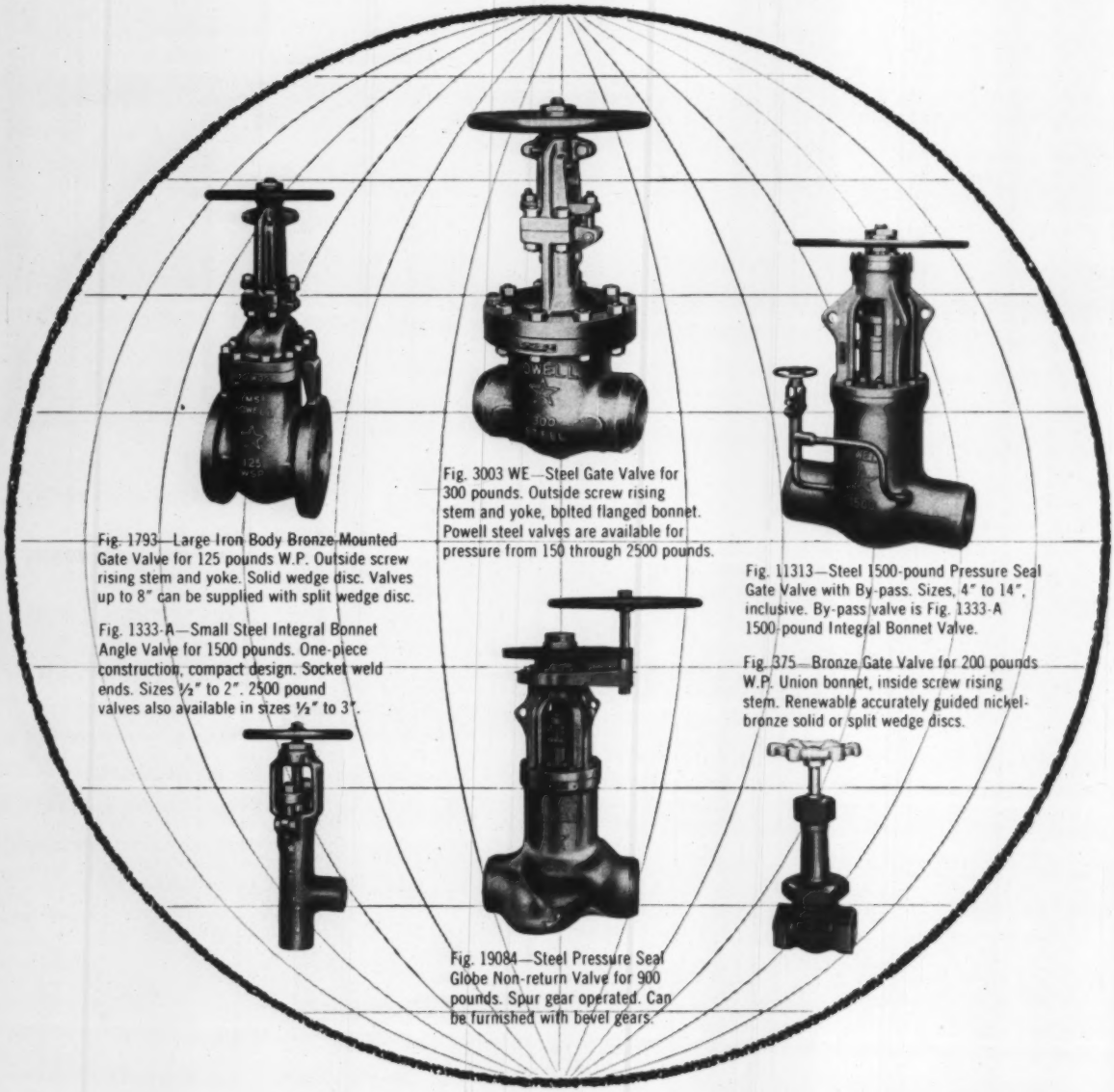


Fig. 1793—Large Iron Body Bronze-Mounted Gate Valve for 125 pounds W.P. Outside screw rising stem and yoke. Solid wedge disc. Valves up to 8" can be supplied with split wedge disc.

Fig. 1333-A—Small Steel Integral Bonnet Angle Valve for 1500 pounds. One-piece construction, compact design. Socket weld ends. Sizes ½" to 2". 2500 pound valves also available in sizes ½" to 3".

Fig. 3003 WE—Steel Gate Valve for 300 pounds. Outside screw rising stem and yoke, bolted flanged bonnet. Powell steel valves are available for pressure from 150 through 2500 pounds.

Fig. 11313—Steel 1500-pound Pressure Seal Gate Valve with By-pass. Sizes, 4" to 14", inclusive. By-pass valve is Fig. 1333-A 1500-pound Integral Bonnet Valve.

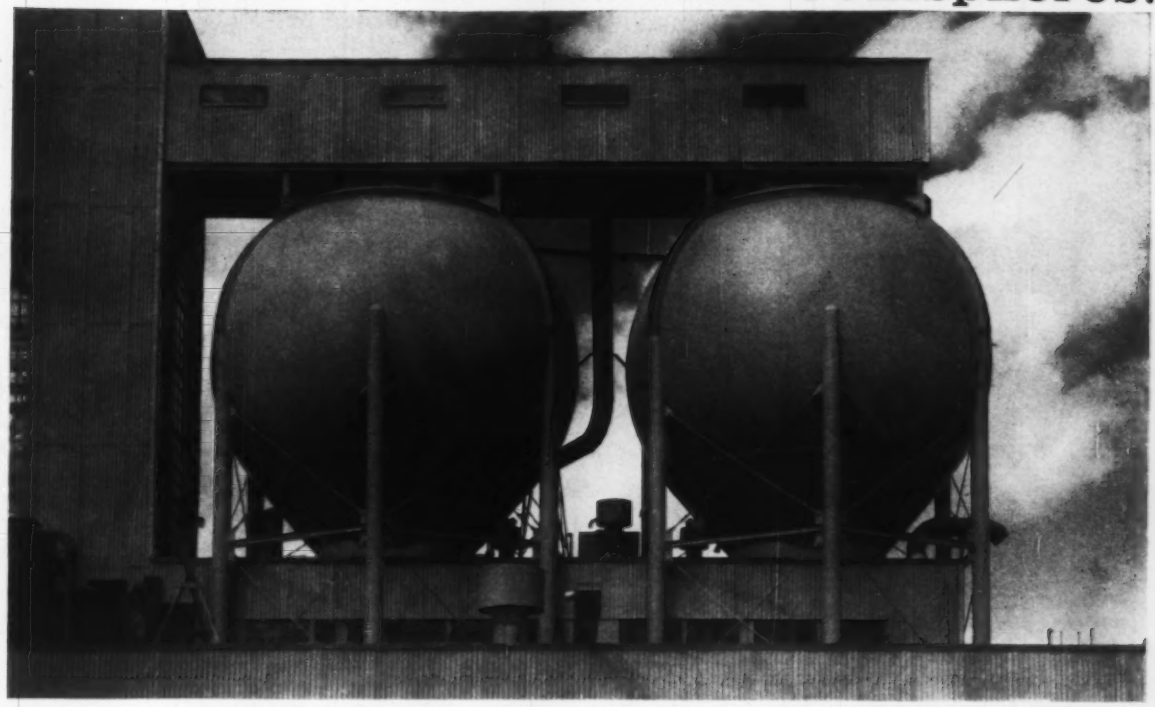
Fig. 375—Bronze Gate Valve for 200 pounds W.P. Union bonnet, inside screw rising stem. Renewable accurately guided nickel-bronze solid or split wedge discs.

Fig. 19084—Steel Pressure Seal Globe Non-return Valve for 900 pounds. Spur gear operated. Can be furnished with bevel gears.

A solution for every kind of flow control problem is as near as your local Powell distributor. Powell valves are designed and engineered in the largest variety of metals and alloys, to handle any medium, every flow control requirement. There are Powell distributors in all principal cities. Or, if yours is a special engineering problem, write to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

The Case of the Airborne Conispheres:



Why Linde wanted them . . . How CB&I designed and built them

In order to keep a ready and free-flowing supply of calcium carbide available for generation into acetylene, the Linde Company specified that these two 500-ton capacity Conispheres* be installed on the roof of their Montague, Michigan, plant. In order to overcome a specific set of problems it was necessary for CB&I to incorporate special features into their design and construction. Here's how it was done:

Problem: *Insure safe, continuous operation.*

Solution: (1) Structures were designed to meet a specified emergency condition at an increased stress level, as well as to meet normal service conditions at normal stress levels in all parts not governed by explosion conditions. (2) A series of six safety outlets vent tanks upward. (3) Heavy baffle plates were suspended inside the tanks to control flow of carbide.

Problem: *Tanks must support superimposed load of gallery and feed belt equipment.*

Solution: Special framing distributes load to supporting columns of the tanks.

Problem: *Tanks must be mounted on sloping roof.*

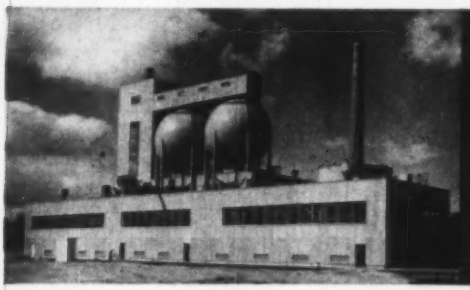
Solution: Three of the supporting columns are longer than others to compensate for roof plane.

Fully coordinated facilities for the design, fabrication and erection of standard or special steel plate structures permits CB&I to work to the most exacting requirements. . . . For this reason industry leaders call on CB&I for the tough jobs and rely on the quality of workmanship that goes into *any* CB&I built structure. A new booklet describes CB&I FIELD SERVICES . . . write our nearest office.

At Montague, Michigan, Linde is one of three major companies combining their talents and mass production facilities to produce DuPont *Neoprene*. Linde Company is a division of Union Carbide Corporation.

*A Conisphere is a Hortonsphere® designed with conical bottom outlet.

E55C



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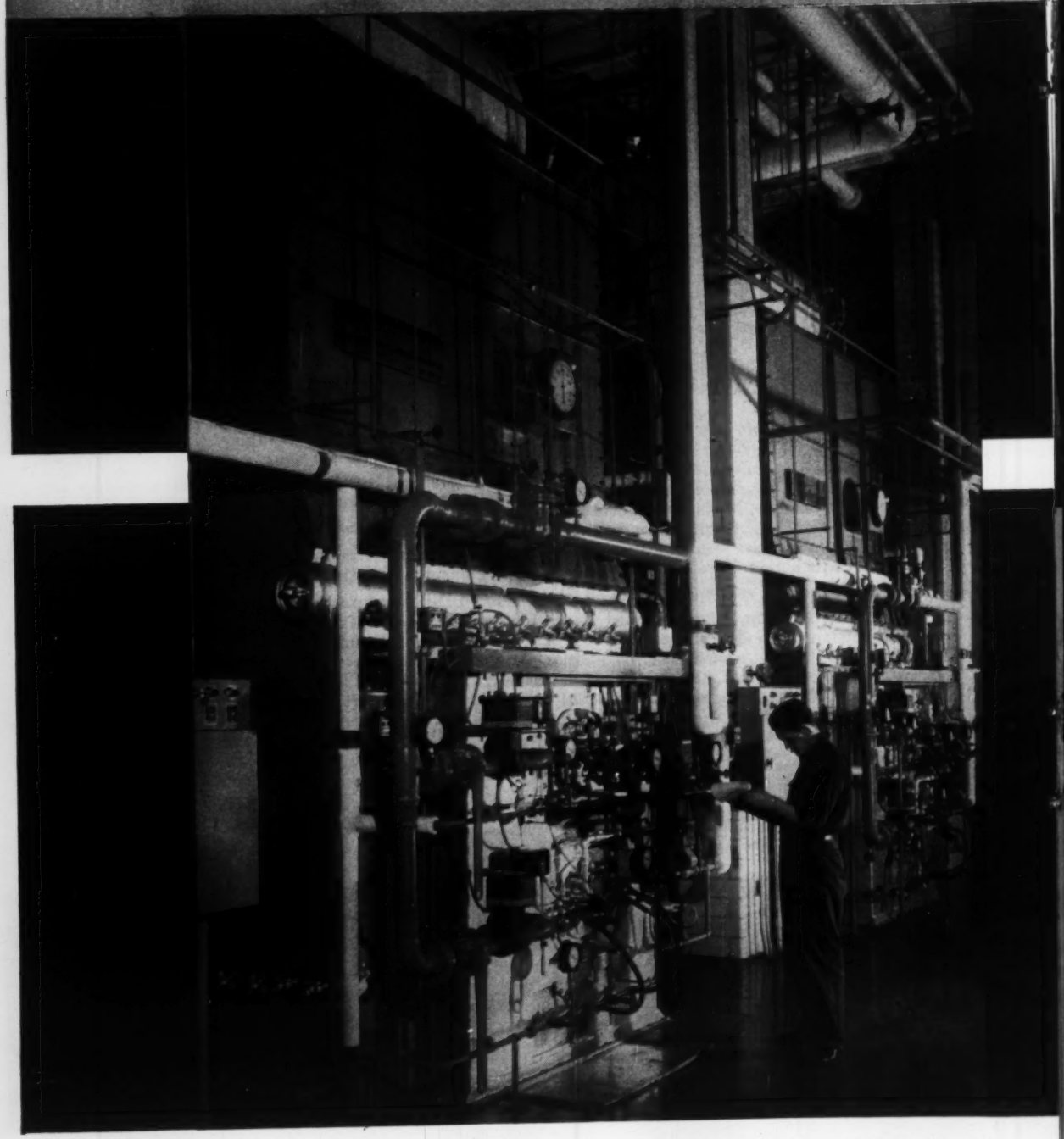
WICKES TYPE S-1AL

HEAT ONE OF AMERICA'S



STEAM GENERATORS
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CONNECTICUT GENERAL LIFE INSURANCE CO., Bloomfield, Conn.

ARCHITECTS:
Skidmore, Owings & Merrill

GENERAL CONTRACTOR:
Turner Construction Co.

MECHANICAL CONTRACTOR:
Kerby Saunders, Inc.

A recent exhibit at the National Gallery features 10 of America's most modern buildings. The American Institute of Architects, on the occasion of its Centennial, included in the exhibit the new home office of the Connecticut General Life Insurance Company in suburban Hartford, which is equipped with Wickes boilers. This spacious, sun-flooded building of steel and glass, is nearly a modern city in itself, for it houses not only the complete office system, but includes employee lounges, game rooms, medical department, mailrooms, auditorium, bowling alleys, barber and beauty shops as well.

For the heating system in this mammoth structure, engineers chose to install two Wickes type S-1AL steam generators equipped with both oil and gas burners. In addition to general heating, the steam generators provide power to operate the refrigeration machines and a snow-melting system on the truck ramp. The boilers each have 3700 sq. ft. of heating surface, and were designed for a maximum continuous load of 27,500 pounds of steam per hour at 200 PSIG.

Bulletin No. 55-1 gives complete facts on Wickes products. New engineering bulletins on Type-S and Type-A Steam Generators are also available on request.

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DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

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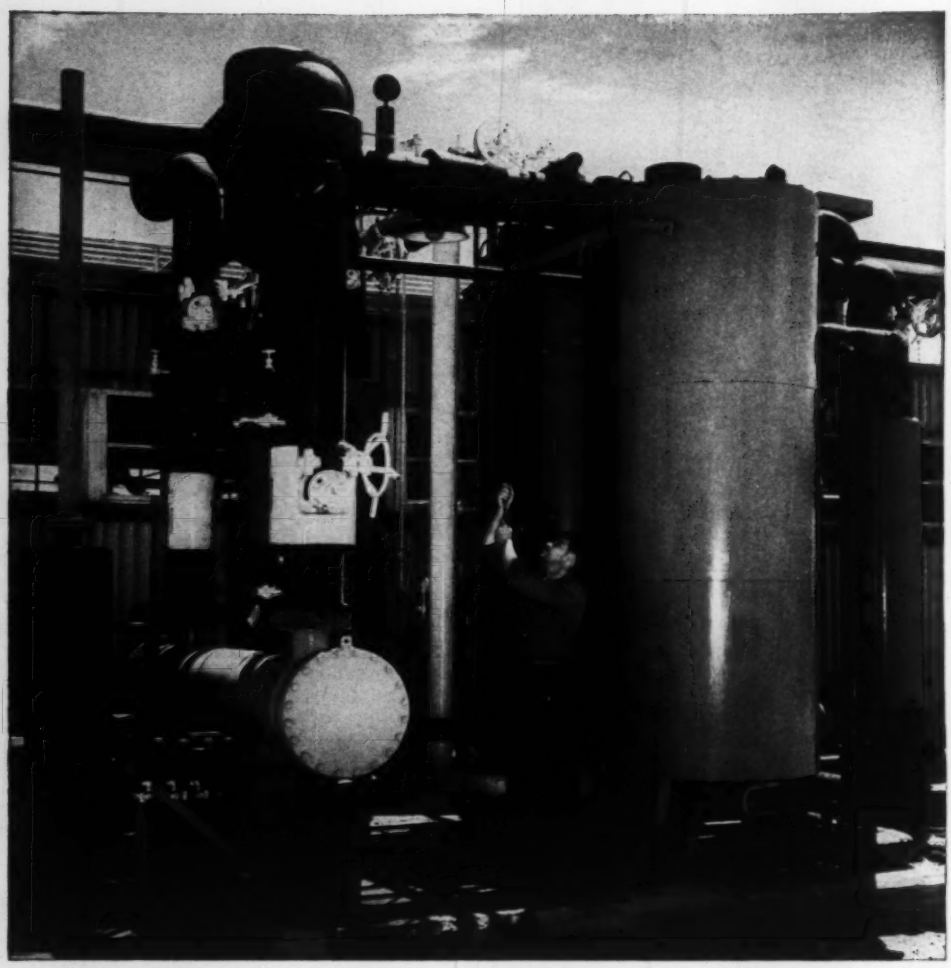

Type BWC Lectrodryer on-stream at Hooker Electrochemical Company, Montague, Mich.*

DRY hydrogen required for production and pipeline transmission

Hydrogen, a by-product from electrolysis of sodium chloride brine, is used for producing anhydrous HCl gas. It must be DRY for this purpose, so Hooker Electrochemical passes it through this Lectrodryer*.

This DRYing also makes it possible to transmit the gas through uninsulated pipes during cold weather. There's no moisture in the hydrogen to cause freezeups.

On-stream continuously, the Lectrodryer handles this DRYing without interruption. Its valves are reversed every eight hours, putting one tower on DRYing while the other is being regenerated. No other attention is required.

Because Moisture Isn't Pink tells how others are using Lectrodryers. For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company 335 32nd St., Pittsburgh 30, Pa.

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"Buffalo" CCL Close-Coupled Pumps can't be beat where space is limited. They are easy to install with permanently aligned shafts and adjustable discharge angle. This provides extreme adaptability in piping and mounting.

Thanks to 81 years of engineering experience, "Buffalo" Close-Coupled Pumps insure you a long, trouble-free life of dependable service. Their rugged construction includes heavy cast mounting brackets, sturdy shells, accurately machined impellers, and deep stuffing boxes.

Where you need space-saving pumps, designed to deliver *extra* years of clear water service, be sure to use "Buffalo" CCL Close-Coupled Pumps, capacities to 1100 GPM. Bulletin 975-D gives you full information. Write for it today.

You're assured of value in "Buffalo" products by the "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

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DIVISION OF BUFFALO FORGE CO.

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New Olds-developed machine makes wheel balancing three times more accurate!

Out-of-balance wheels and tires are not only a source of annoyance and tire wear, but also in extreme cases, a detriment to safety by causing excessive shimmy at higher speeds.

To virtually eliminate this problem, Oldsmobile engineers, in conjunction with the General Motors Research Section, have developed a machine that automatically balances every wheel and tire with a degree of precision not previously possible on a production basis. With this equipment, balancing is now accurate to 2 inch-ounces, or approximately three times more precise than before.

The heart of such accuracy is an automatic electronic computing device. After the tire and wheel are located on a delicate sensing table, supported on an air bearing, four differential transformers signal the out-of-balance to an electronic computor. This computor then resolves the vector forces and a signal of the proper magnitude and direction is transmitted to the stamping head which automatically revolves to the correct location on the wheel. The stamping head then prints the correct weight, accurate to .25 ounce. The entire assembly is then moved to a station where the weights are attached.

It has often been said that "Olds really knows how to put a car together." This reputation grew from a sincere concern for just such little-noticed details. A warm welcome awaits you at your Olds dealer's. He invites you to try a '58 Olds on the road.

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GENERAL MOTORS CORP.

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2,000,000 DEFLECTIONS WITHOUT FAILURE.....Severe fatigue tests show Duraflex,® Anaconda superfine-grain Phosphor Bronze, permits far higher design stress

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Complete engineering and manufacturing services including design and development of special machinery, mechanical products and spring activated mechanisms. Stress analysis, spring design, metallurgical data, heat treatment, plant layout, engineering reports, selection of materials and equipment. Tools and products.

The American Brass Company,
99 Park Avenue,
New York 16, New York.

October 25, 1957.

Gentlemen, SUMMARY OF ENGINEERING LABORATORY REPORT NO. 102557

SUBJECT: Fatigue Life Test of "Duraflex", Superfine-Grain Phosphor Bronze and Commercial Quality Grade A Phosphor Bronze spring wire.

SPECIMENS: Compression springs made from each material, were coiled on arbors to avoid tool marks. The springs had squared ends, a high pitch to obtain high stresses and were heated after coiling in boiling water for 1 hour to relieve residual coiling stresses.

CALIBRATIONS: Each spring had its physical dimensions measured with micrometers and vernier calipers and was load tested in a Comaco Elasticometer Precision Spring Testing Instrument, before fatigue testing and after each 100,000 cycles of deflection to determine loss of load, if any.

FATIGUE TESTING: A representative number of springs from each material were tested simultaneously under identical conditions.

STRESSES: The stress in the springs, including curvature correction, during the tests were as follows:

Stress at Initial Installed Position	36,600 p.s.i.
Stress at Final Deflected Position	73,200 p.s.i.
Stress Range during deflection	36,600 p.s.i.

These stresses, for endurance limit testing, are exceptionally high for phosphor bronze spring wire - far higher than those ordinarily recommended for Beryllium-Copper or Stainless Steel for such severe service and are comparable to those used for good quality Spring Steel.

RESULTS: Grade A Springs broke at average deflections of 505,700.

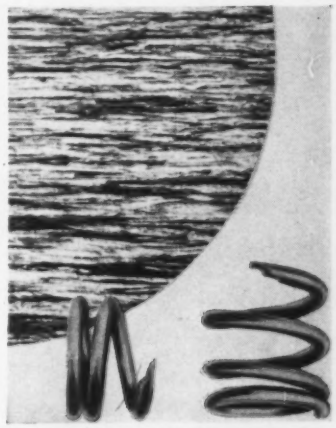
Duraflex Springs were still satisfactory with no appreciable loss of load at 2,000,000 deflections.

CONCLUSIONS: 1. Design stresses for Duraflex can be at least 33% higher than those used for Grade A Phosphor Bronze and as high if not higher than design stresses recommended for Beryllium Copper.

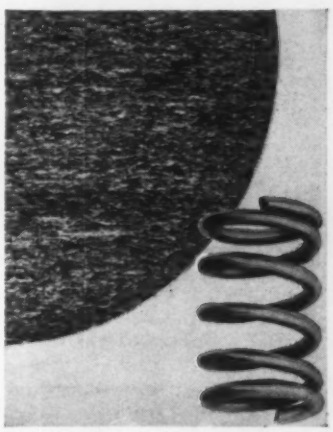
2. High endurance and long fatigue life at high stresses can be expected from springs made of Duraflex Phosphor Bronze.

CERTIFICATION: We certify the above summary of our report is accurate, in accordance with the facts and is true in every respect.

Respectfully submitted,
THE CARLSON COMPANY
Harold Carlson
Harold C. R. Carlson, P.E.
Licensed Professional Engineer.



Spring of Alloy A Phosphor Bronze, shown actual size, which broke just after 500,000 deflections. Micrograph (75x) shows typical grain structure of this metal.



Spring of Duraflex showed no appreciable loss of load after 2,000,000 deflections in same test. Micrograph (75x) shows typical superfine-grain structure of Duraflex.

Duraflex is a registered trade-mark for a higher quality phosphor bronze in sheet and wire forms, recently developed by American Brass Company research. Yet it costs no more than regular phosphor bronze. For detailed information—for a copy of the test data—write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5845

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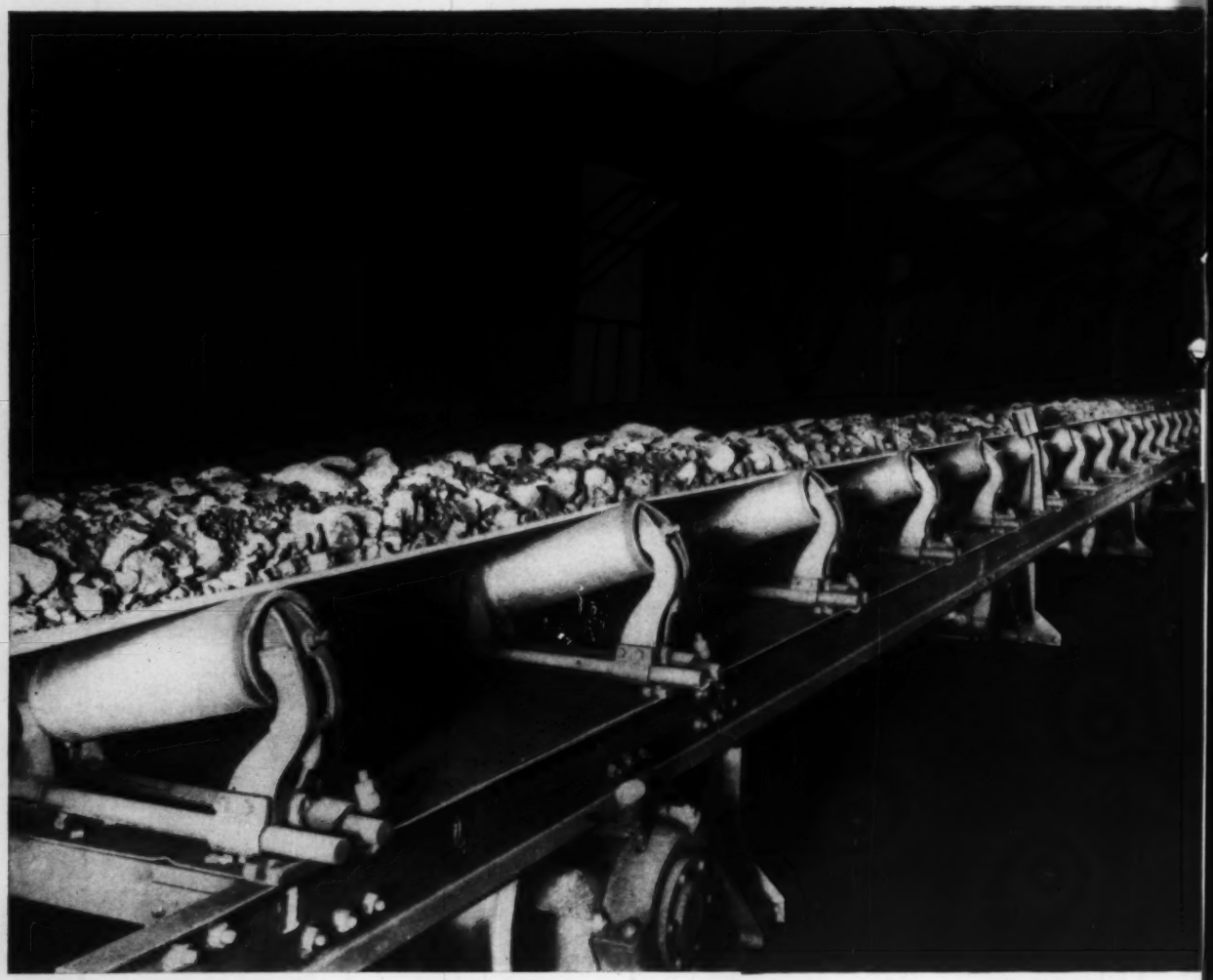
A product of
ANACONDA®
Made by The American Brass Company

WORLD'S FIRST LONG DISTANCE



Forerunner of most present day conveyor systems, this conveyor operated at 500 feet per minute, handling 1,200 tons per hour, back in 1924 . . . a previously unheard of record.

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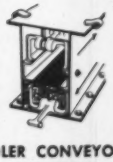
THE BIG NAME IN BULK MATERIALS HANDLING

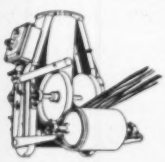
BELT CONVEYORS

BIN GATES — ALL KINDS

MANGANESE STEEL PAN FEEDERS



REDLER CONVEYORS, ELEVATORS



SWIVELOADERS

BUCKET ELEVATORS & CONVEYORS

CONVEYOR CELEBRATES 34TH BIRTHDAY

DOING DOUBLE DUTY FOR H. C. FRICK COKE CO.

Back in the early 20's, the H. C. Frick Coke Co. was faced with a serious problem — movement of 8,500 tons of coal production, per day, from its Colonial Mines to the Colonial Dock on the Monongahela River, four and one-third miles away. The wagons in use at the mines had an average capacity of about 2.1 tons each, and to transport 8,500 tons would require 4,000 wagon loads or forty trips of one hundred wagons each. This would allow only 12 minutes between trips throughout an entire eight-hour day . . . a very unsatisfactory arrangement.

Up to that time, belt conveyors had not been developed to where they were considered a transportation system and were used for short distances only. With the hope that some solution to the problem could be developed, Frick engineers invited the leading conveyor manufacturers of the country to study the problem and through development of the first ball bearing anti-friction carrier, STEPHENS-ADAMSON presented a workable solution.

The answer has become one of the real wonders of the conveying world . . . an underground river of coal, five and four-tenths miles long, whose performance has surpassed the customer's own expectations. Today — after 34 continuous years of operation — the system has successfully conveyed around 90,000,00 tons of coal and 90% of the original 6,598 3-pulley anti-friction carriers and 2,281 return rollers plus 85% of the 39,588 ball bearings are still performing efficiently.

The system has won world-wide renown and has been inspected by mining enginers from all over the world, whose names are inscribed on a register at Colonial Dock.

Put into operation on April 12, 1924, with a rated capacity of 8,500 tons of coal per eight-hour day, the capacity of the system has been continually increased and today conveys over 1,800 tons per hour, more than 50% over original rated capacity.

This is but one more first in the annals of STEPHENS-ADAMSON engineering achievements . . . factual proof that STEPHENS-ADAMSON "know-how" is unequalled.

MYRON A. "Mike" KENDALL, Chairman of the Board — pioneered the long distance belt conveyor and developed the first successful anti-friction ball bearing carrier. "Mike" was recently awarded the coveted A.S.M.E. "Fellow" Award for his outstanding contribution to the field of engineering.

Originally the H. C. Frick conveyor system consisted of 20 continuous belt conveyors. But in January 1925, belts No. 8 and 9 were combined into one unit, 2,435 feet long, to make the longest single conveyor belt in the world.

-ADAMSON

EQUIPMENT

S-A district or main plant offices can supply complete information on any conveyor product or any phase of ore and stone handling. Bulletins on all products available upon request.

S-A

MFG. CO.

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AURORA • ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA
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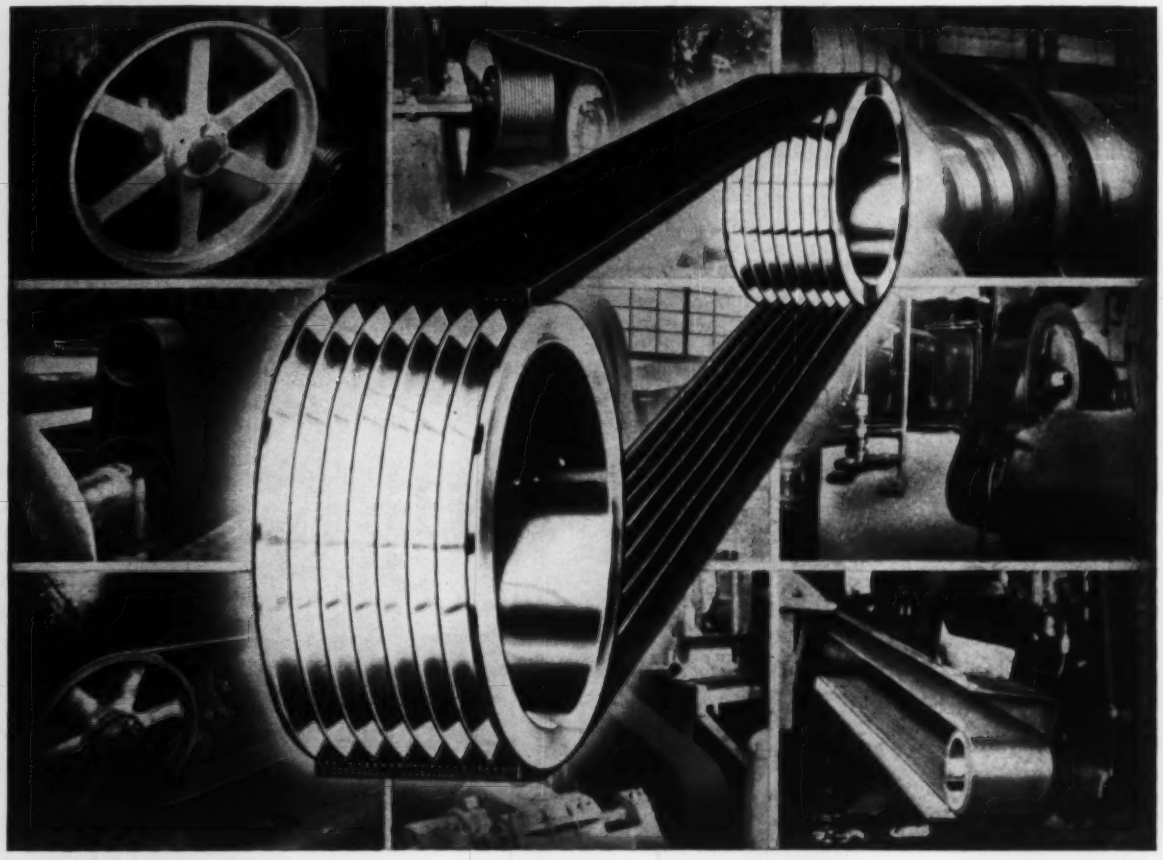


R/M *Poly-V*® Drive Delivers More Power in Less Space

...*"More Use for your ~~per~~ Dollar"*

R/M's patented new drive design is the reason. R/M Poly-V Drive employs a *single*, endless, parallel V-ribbed belt running on sheaves designed to mate precisely with the belt ribs. Flat belt strength and simplicity *plus* the high V-groove grip of V-belts adds up to *twice* the tractive surface of ordinary multiple V-belts. It's proved in actual performance on drive after drive, to deliver up to 50% *more* power in the *same* space as a multiple-belt drive . . . *equal* power in as little as ⅔ the space! Other features are equally important:

- *No* Belt "Matching" Problems . . . Reduced Downtime Costs
- Uniform Tension and Constant Speed Ratios—*No* Load to *Full* Load!
- Smoother, *Cooler* Running . . . Oil Proof, Non Spark, Heat Resistant
- *Less* Shaft Overhang . . . *Less* Drive Weight
- *Two* Belt Cross Sections Meet *Every* Heavy Duty Power Transmission Requirement

Greater power delivery and dependability for *every* drive dollar begins when you specify R/M Poly-V* Drive. R/M engineers who developed it will assist you in determining the best installation for your application. Contact your R/M representative . . . or write for Poly-V Drive Bulletin #6638.

**Poly-V is a registered Raybestos-Manhattan trademark.*

RM 830

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

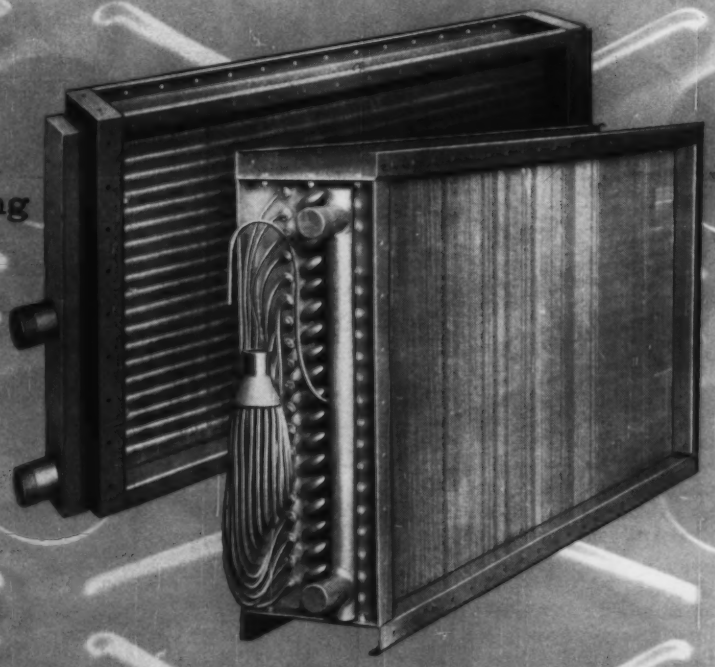
MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

When you need heating and cooling coils...

these are better



because of this!

Air Activating Guides

This Westinghouse fin design activates air ... does away with dead-air film

All Westinghouse continuous Plate-Fin Coils feature:

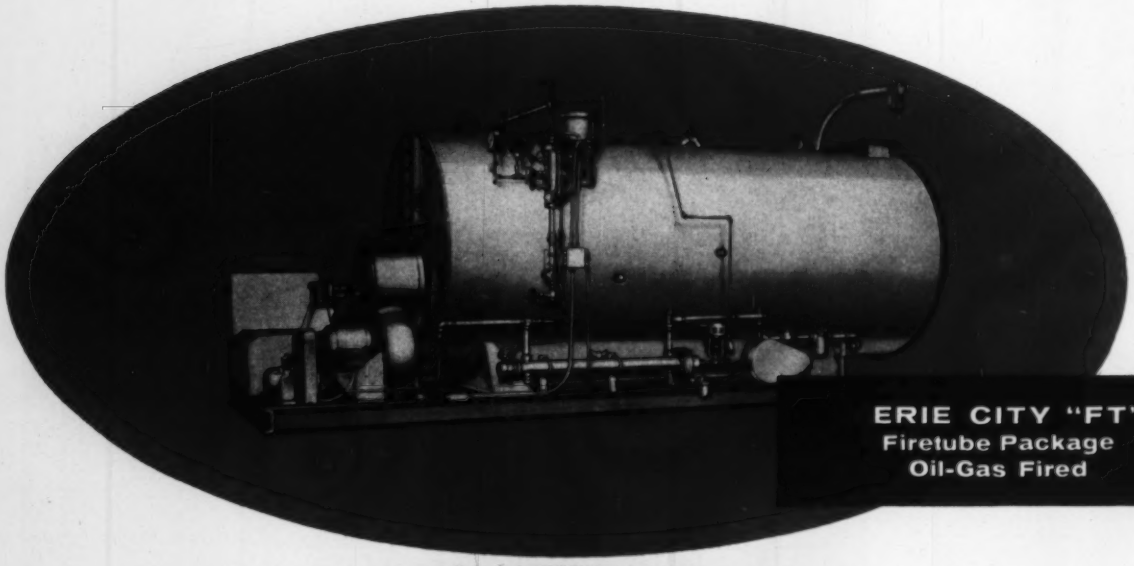
- *Permanent Mechanical Bond—Fin to Tube*
- *Minimum Air Resistance*
- *Guaranteed Published Performance*
- *Wide Selection*

And for heavy-duty industrial process and high-pressure steam heating . . . standard sections with extra-heavy wrought-iron finned pipe are available.

Call your Sturtevant Division Sales Engineer for complete details on your heating and cooling coil requirements, or write Westinghouse Electric Corporation, Department E-3, Hyde Park, Boston 36, Massachusetts.

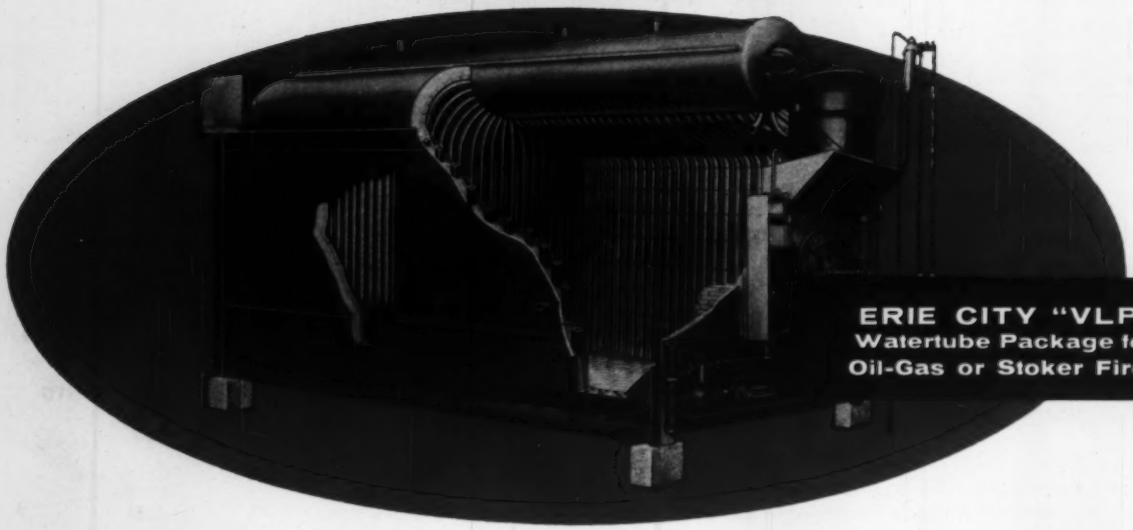
J-80654

YOU CAN BE SURE...IF IT'S Westinghouse



ERIE CITY "FT"
Firetube Package
Oil-Gas Fired

ERIE CITY "KEYSTONE"
Watertube Package
Oil-Gas Fired



ERIE CITY "VLP"
Watertube Package for
Oil-Gas or Stoker Fired

Why shop around for Package Boilers?

Thinking about a new boiler these days? Maybe a package boiler! Sounds like a good idea because many people like this new concept of undivided responsibility. But what kind should we get? Firetube? . . . Watertube? Should it be oil fired, gas fired, arranged for future stoker firing; or which combination of these would be best for us?

The best place to find unbiased answers to your questions is Erie City Iron Works—a pioneer in the boiler industry and a leader in the package steam generator field. Erie City manufactures both firetube and watertube package units. Without prejudice their engineers can point out the advantages of both types.

After hearing the pros and cons of each, you may decide on the firetube type. Erie City offers its modern "FT" Package Boiler arranged with Erie City air atomizing oil gun and/or ring type gas burner. The "FT" Fire Tube Package unit is built to highest quality standards—not down to a price. It is a three pass design with gas vent at the rear and pressurized, using forced draft to provide precise control of excess air and CO_2. A centrifugal fan is used, which coupled to a closed combustion chamber, results in unusually quiet operation. No costly foundation—no expensive stack—no brickwork are required.

"FT" *Cat.* SB5684E

If a watertube boiler is your choice, you have two types available from Erie City. One is the KEYSTONE, the most compact water tube package available, arranged with a steam atomizing oil gun and/or ring type gas burner. The KEYSTONE is a baffleless, two drum unit completely water cooled with a seal welded inner casing and bolted outer casing for pressurized operation. No costly foundation—no expensive stack—no brickwork are required.

The other choice for a watertube package is the VLP. Your plant may be located in an area where gas, oil and coal are all available. At first you may decide to fire with oil or gas but desire the proper provision for future coal firing. The boiler for you to install is an Erie City VLP arranged for present oil and gas firing but with the furnace PROPERLY PROPORTIONED for the future installation of an underfeed or spreader stoker.

"KEYSTONE" *Cat.* SB5984E

All Erie City package units come complete with burners, fans and safety and combustion controls, piped, wired and mounted on the boiler. No field work required—just make basic fuel, water, steam and electric connections and you're ready for operation.

Both the air atomizing and steam atomizing burners are of Erie City's own design and manufacture. No division of responsibility here. Qualified service engineers will assist at start up and instruct your operating personnel. In the case of the VLP, your boiler will be properly designed for future conversion to either Erie City underfeed or spreader stoker firing. Again, no division of responsibility.

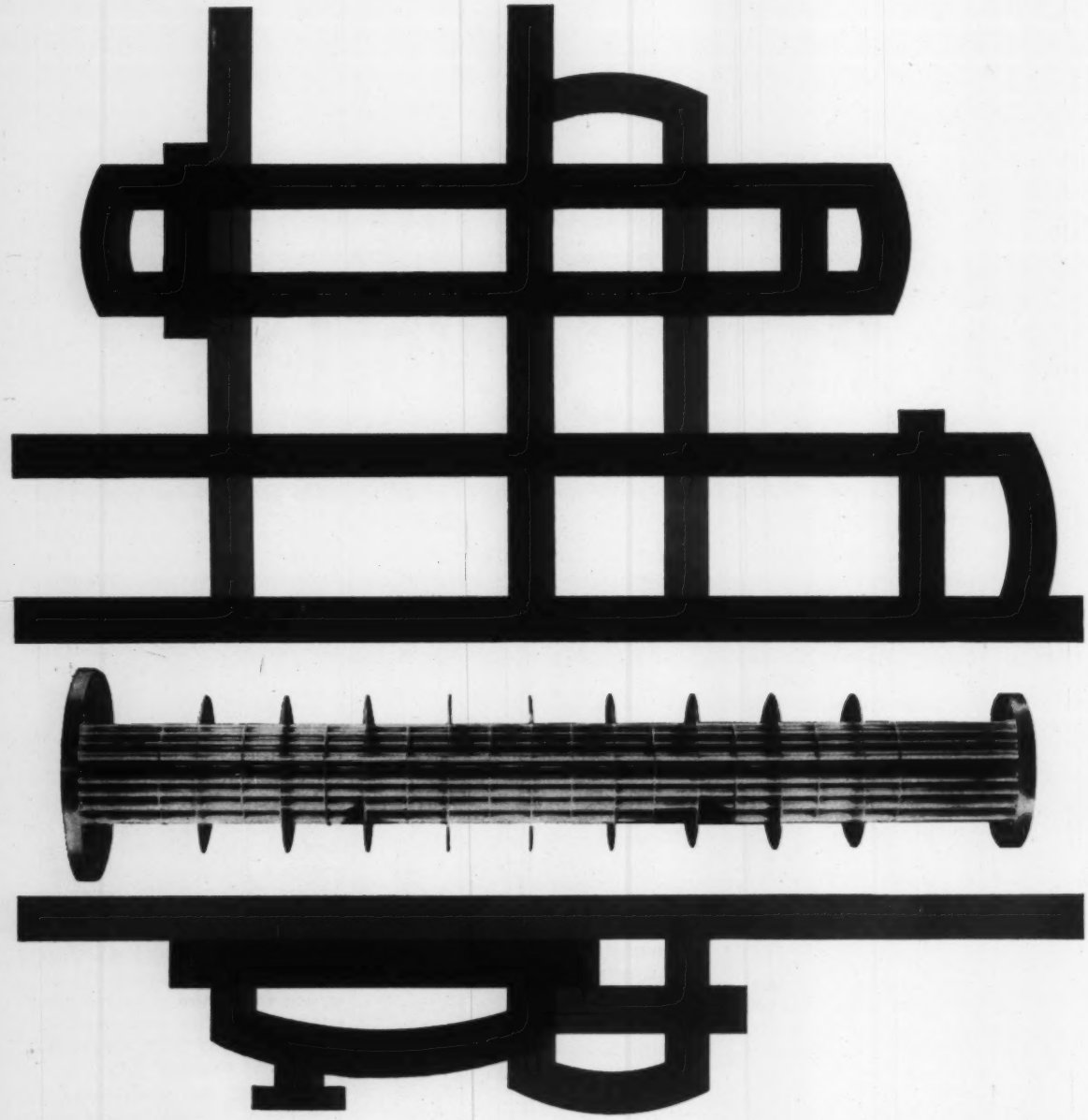
Don't let the selection of a new boiler become an unnecessary problem. Write and let Erie City help make the proper selection of a package steam generator for you.

"VLP" *Cat.* SB5784E

• *You can depend on* ERIE CITY Since 1850 *for sound engineering*

ERIE CITY IRON WORKS *Erie, Pennsylvania*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS • WASTE HEAT BOILERS
FIRE and WATER TUBE PACKAGE BOILERS • OIL and GAS BURNERS • STOKERS • PULVERIZERS



win the fight against corrosion—with Alcoa Aluminum

Here's a $100-million example. The refining industry's requirements for heat exchanger tubes are 40 ft per barrel of capacity. Some 30 ft of this requirement involves exchanger applications in which Alcoa has proved aluminum is ideal. By using aluminum tubes in all those applications, the refining industry would have saved approximately $37 million in original capital investment. Capitalized at the refining industry's normal rate of return, that saving would be worth about $100 million over a 10-year operating period.

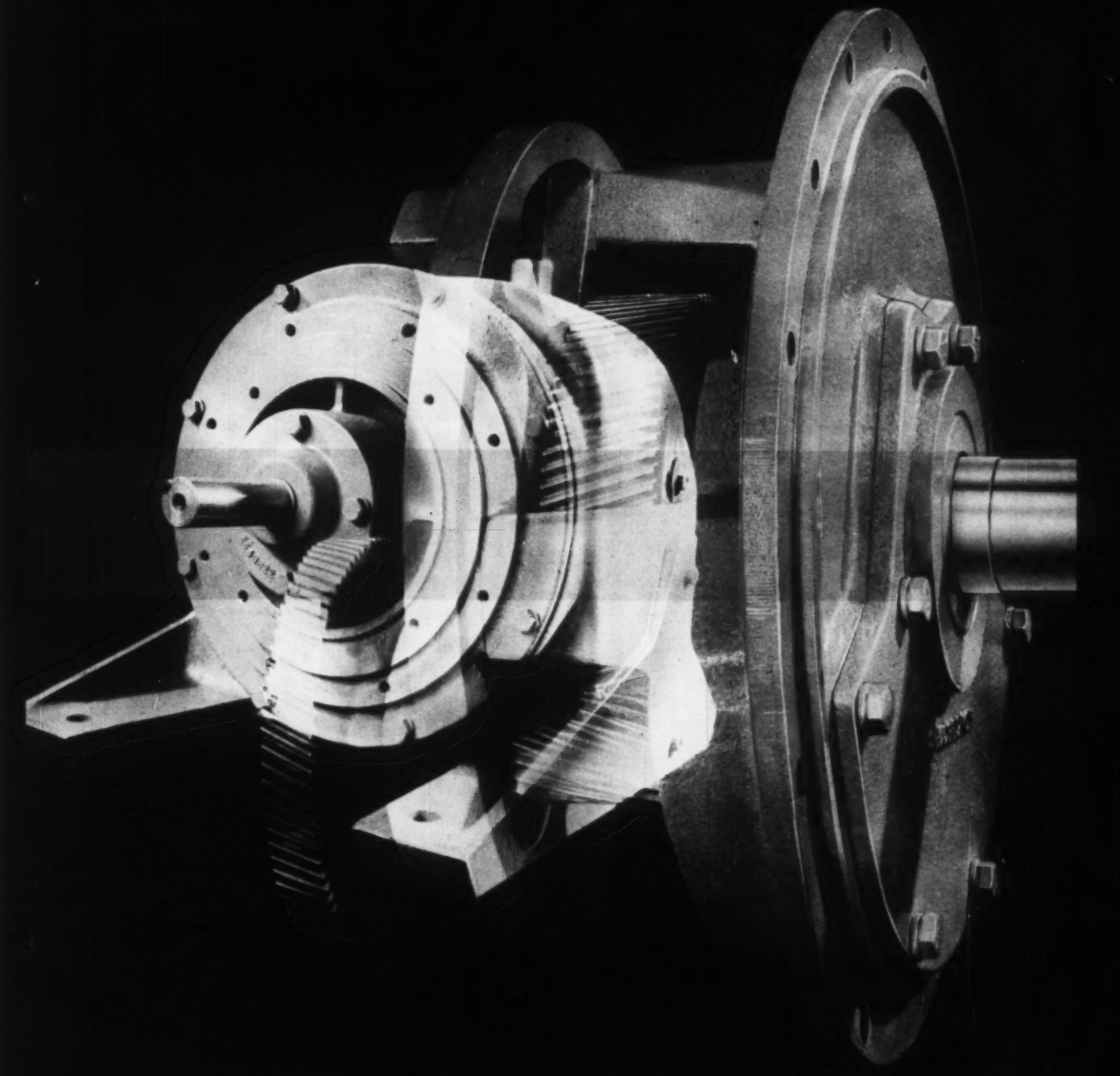
Don't shovel good money after bad by reinstalling unsuitable material. Over 30 years' experience in the process industries has given Alcoa engineers full knowledge of the aluminum alloys and installation methods by which corrosion can be eliminated. Put their knowledge to work for you. Outline your corrosion problems in a letter to ALUMINUM COMPANY OF AMERICA, 894-E Alcoa Building, Pittsburgh 19, Pa.

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

ALCOA CHEMICALS

Specify Alcoa Aluminum for
corrosion-free Process Equipment
Pipe & Tube
Tanks, Containers, Trucks & Cars
Plant Structures

EXCLUSIVE DEVELOPMENT OF WESTINGHOUSE ELECTRIC CORPORATION

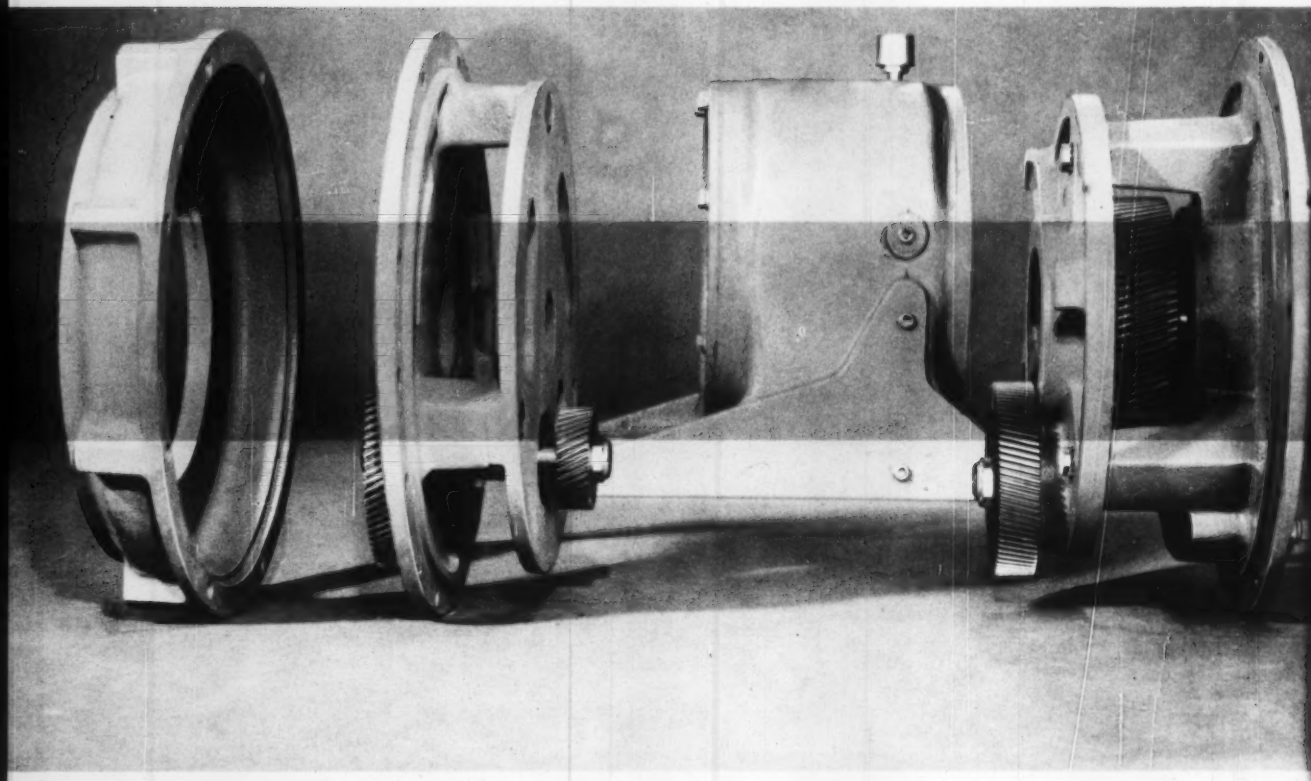


NEW MODULINE GEAR UNITS

OFFER YOU ORIGINAL ADVANTAGES IN
SIMPLICITY • VERSATILITY • DEPENDABILITY

MODULINE

IS ORIGINAL IN SIMPLICITY...IN VERSATILITY



Basic Moduline components combine to form double, triple or quadruple reduction speed reducers, gearmotors or package motor reducer drives with gear ratios from 4.17:1 to 985.3:1.

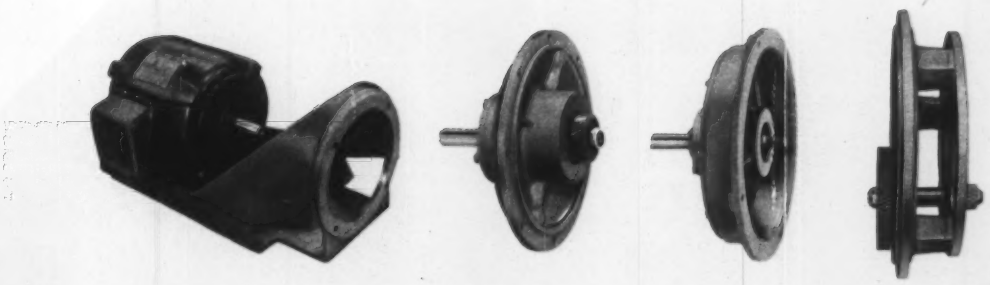
These preassembled modules standardize over 20,000 variations of gearmotors, speed reducers and package motor reducer drives

Look over the simplicity, dependability and versatility you get from Westinghouse Moduline gear units. Here you'll find original answers to solve long-standing problems in application of gearmotors and package motor reducer drives from 1 to 30 hp; foot-mounted speed reducers from 1 to 75 hp; and shaft-mounted speed reducers from 1 to 40 hp, including concentric shaft and right angle configurations.

What's more, just seven Moduline frame sizes cover these broad ranges. By ordering Moduline drives, together with any type of Westinghouse Life-Line® motors, you combine two purchases in one order with complete assurance of design and application coordination.

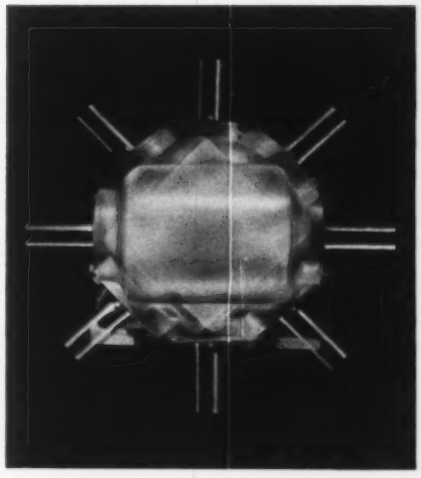
JI-07368-2

EXCLUSIVE DEVELOPMENT OF



Moduline originality offers application and maintenance savings

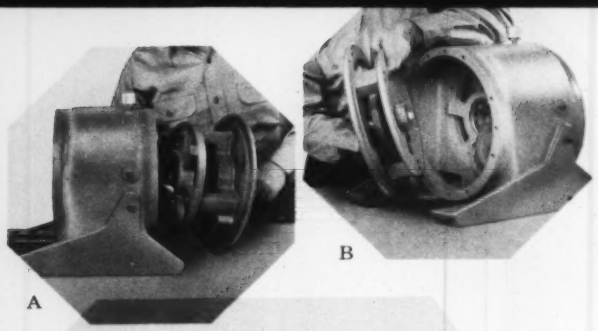
Here are subassemblies for the most versatile gear drives on the market. From these modules . . . concentric shaft or right angle . . . integral gearmotors, package motor reducer drives and speed reducers can be assembled exactly to your specifications. Motor support brackets, right angle heads (in fact, all Moduline parts) go together in thousands of different ways to make the right drive for any job.

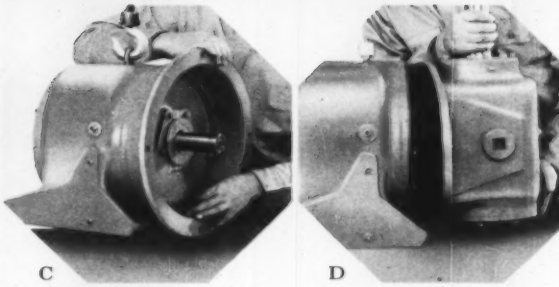


Moduline units can be installed in any location. Concentric shaft units can be mounted in any position on the floor, wall or ceiling . . . or at any angle in between. The output shafts of right angle units can be indexed in 8 or 12 positions for power take-off in almost any direction. Units are designed for electric motor or engine drive; chains, belts or gears may be used to put power into or take it out of them. Only Westinghouse offers Moduline units with right angle input or output assemblies. These 1 to 75 hp reducers with ratios from 7.6:1 to 985.3:1 can handle any job.

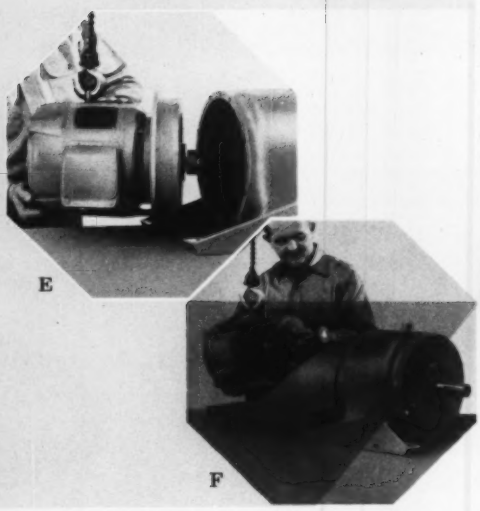
JI-07368-3

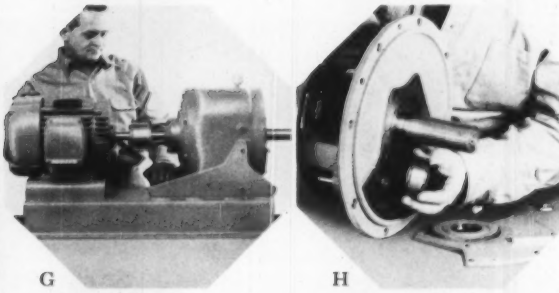
WESTINGHOUSE ELECTRIC CORPORATION





For *speed reducer* assemblies (above), reducer case and low-speed cage assembly with 5:1 gear ratio combine with high-speed change pinion and gear set (A) which are available in nine standard ratios from 1:1 to 5:1 and for double reductions up to 25:1. For triple and quadruple reductions, add change gear set and high-speed cage assembly (B) . . . with either a 5:1 or a 25:1 ratio . . . for total ratios up to 625:1. For *vertical mounting*, add flange and face-type seal (C). For *right angle* output units, add head assembly (D).





Gearmotors and package motor reducer drives are assembled with AGMA standard flange-mounted motor (E) or NEMA standard foot-mounted motor, with either "sugar scoop" motor support (F) or combination bedplate (G). Backstop kit (H) can be added to any unit.

A standard wrench assembles or modifies any Moduline unit

Only a wrench is needed to work on Moduline units. Awkward gear pullers and troublesome fitting have been eliminated. It's another example of the original advantages you gain from Moduline design and quality.

Unusual manufacturing processes, preassembly and pilot fits make modular construction possible. All parts are accurately machined within very close tolerances. No checking, aligning or positioning of modules is necessary during assembly.

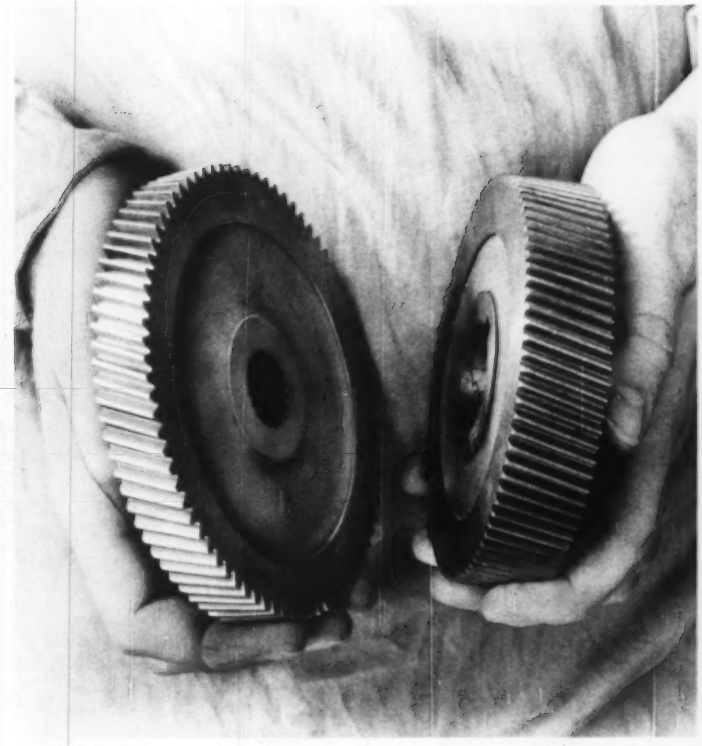
Moduline shafts are roll-formed to provide splined and threaded extensions for simple gear mountings. Pinions and gears have splined bores for ease of assembly. An elastic stop nut locks them in position.

JI-07368-4

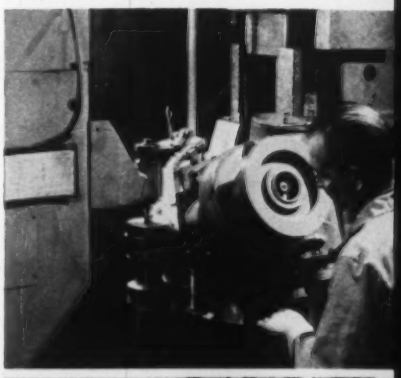
WESTINGHOUSE

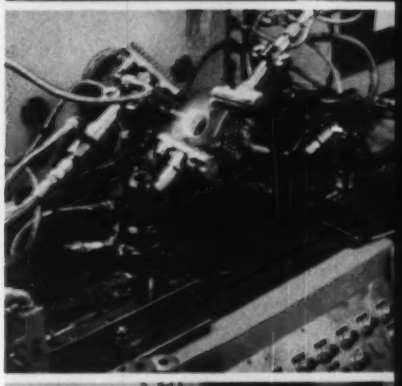
MODULINE

IS ORIGINAL IN DEPENDABILITY



Compare the Moduline ground tooth gear (left) with conventional gear. Note smooth finish, splined bore and drop-forge blank that's standard with all Moduline gears.





(*top*) Precision hobbing cuts Moduline gear teeth on alloy steel blanks

(*middle*) Through-hardening on automatic spin-flame equipment for extra wear resistance

(*lower*) Finish grinding to master gear standards

Only MODULINE combines ground "master gear" precision with tough, wear and shock-resistant alloy steels

See the difference between a conventional gear and a Moduline precision-ground, heat-treated gear. Moduline gear teeth are so accurate they meet AGMA master gear requirements for pin dimensions, pitch error, profile error and lead error. This means unusual dependability with quiet, efficient operation. Previously, you would have to special-order and pay a premium for the quality now made standard by Moduline. These precision gears have low sound levels and increased mechanical capacity. Spin-flame heat treatment and tempering produce hard, wear-resistant surfaces backed up by tough-hardened cores to stand up under all kinds of service.

JI-07368-5

MODULINE

delivery is fast because it's "built in"

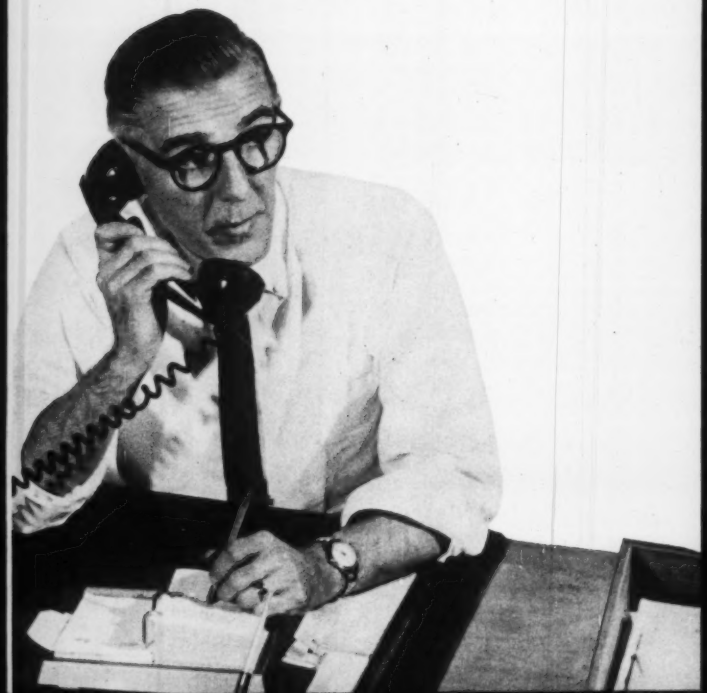
Original modular design and complete standardization of components simplifies specification, inventory control and gives fast deliveries from local Westinghouse warehouses.

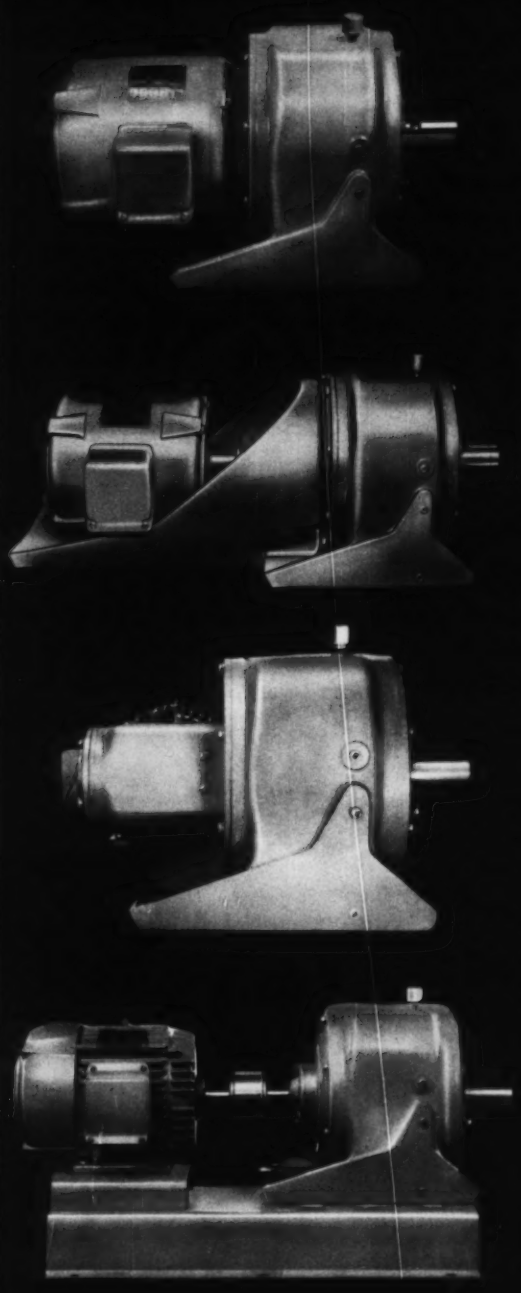
Your local Westinghouse sales office fills your order from a nearby warehouse. Moduline drives are shipped completely assembled to your instructions, ready to go to work. All Moduline warehouses also carry complete stocks of renewal parts and subassemblies for the maintenance or modification of customer units. Fast parts deliveries and serviceability of Moduline designs reduce down time and maintenance costs to a minimum. A small inventory backs up many units for customers who prefer to stock their own parts and subassemblies.

...see MODULINE facts in action

A desk-top demonstration of Moduline scale models is the first step to lower gear drive costs. Your Westinghouse sales representative will arrange a demonstration; or write Westinghouse Electric Corporation, Gearing Division, 200 McCandless Ave., Pittsburgh 1, Pa.

JI-07368-6





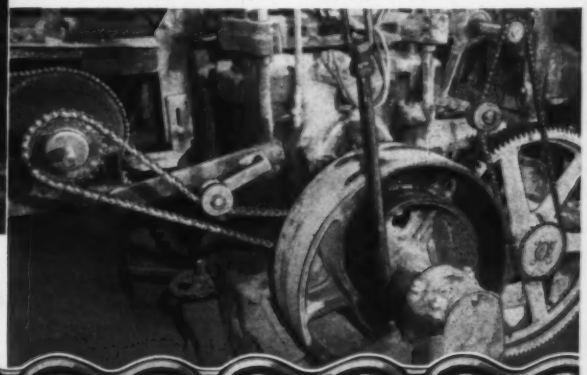
POWER-UP with MODULINE

a complete line of . . .
speed reducers . . . gearmotors . . .
and motor reducer drives

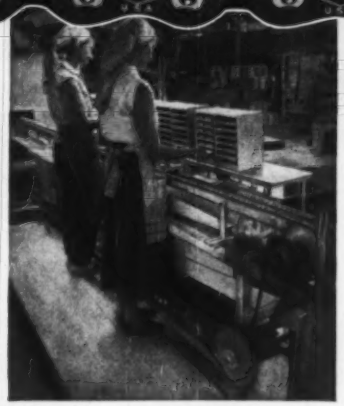
YOU CAN BE SURE... IF IT'S

Westinghouse

Diamond Roller Chain drives have replaced belt drives on six pebble mills. Greatest advantages have been complete freedom to relocate the mills for maximum efficiency, elimination of belt slippage and easy lubrication of the open Diamond Drives. Three strand ½" pitch Diamond Chain operates at 1250 r.p.m. Motors are 7½ h.p.



Modernization of one of eighteen wall tile presses at National Tile. Through the use of Diamond Drives, agitation, turnover and conveying the pressed tile to kiln conveyors is now completely automatic.



Double and single strand Diamond Conveyor Chains carry tiles through the glaze spray booths at 60 feet per minute. Glaze will not stick to the metal chain and the bending of the chain also tends to keep it clean and eliminates contaminating carry-over. The girls are placing the tile in saggers for firing.

Tile stackers use two ⅜" pitch Diamond Roller Chains with standard bent attachments. A cleat riveted to the attachment links on both chains serves as the tile carrier. The stackers collect tiles from a conveyor belt for the operators who sort for shade and grade.

How National Tile & Mfg. Co. Increased Production Efficiency with Diamond Roller and Conveyor Chains

Write now for your copy of Catalog 757. It tells you how to select Diamond Chains for your applications.

◆ Here wide and varied use of Diamond Roller Chain, Conveyor Chain and Sprockets has eliminated much costly hand work, increased output of machinery and helped improve efficiency of skilled labor by providing automatic transportation and positioning of tile at the work stations.

◆ The great strength, small size and light weight of Diamond Roller and Conveyor Chains make it an ideal power and conveying medium. Its uses, as shown by National Tile, are as wide as the skilled engineer's imagination. You have the flexibility of belts, yet the positive drive of gears for perfect timing between many conveyors and machines.

◆ In addition, Diamond Chain and Sprockets are made in a complete range of sizes, capacities and types to meet your requirements immediately from stock.

◆ Your local Diamond Distributor can give you valuable assistance and information. Call him now or write direct for your copy of Catalog 757, just off the press.

DIAMOND CHAIN COMPANY, Inc.

A Subsidiary of American Steel Foundries

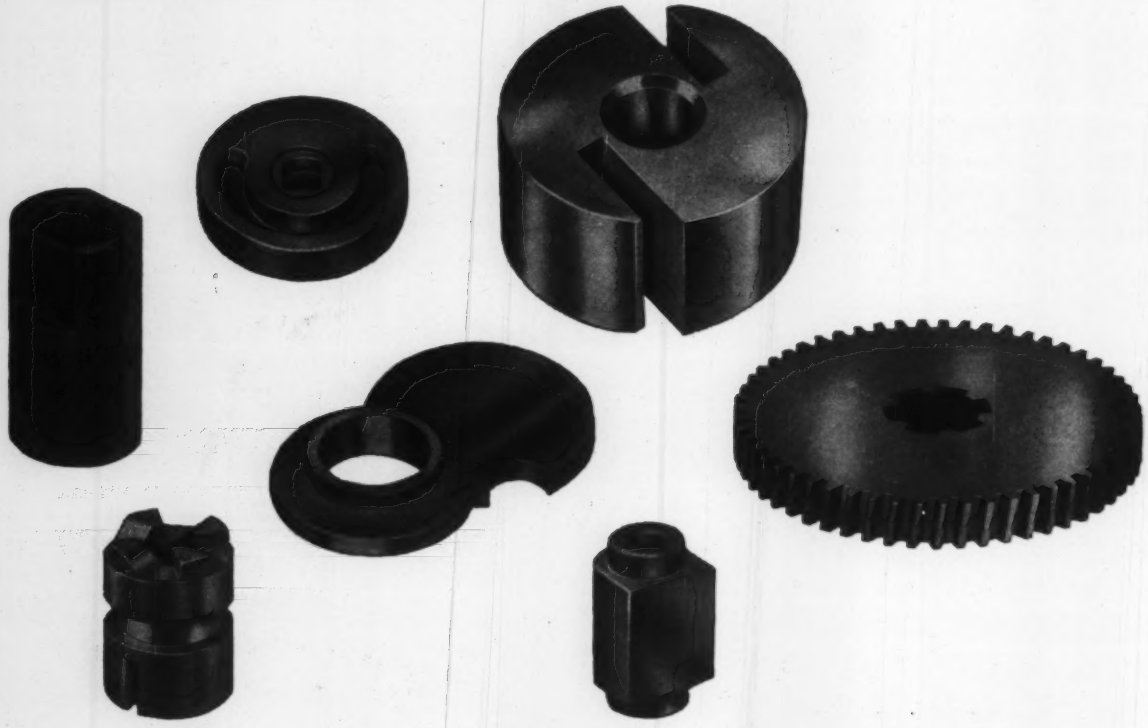
Dept. 413, 402 Kentucky Ave., Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

Please refer to the classified section of your local telephone directory under the heading CHAINS OR CHAINS-ROLLER.

DIAMOND ROLLER CHAINS

regardless of SHAPE...



economical GRAMIX®

(PRODUCTS OF POWDER METALLURGY)

in the exact form to meet your ...ready to install!

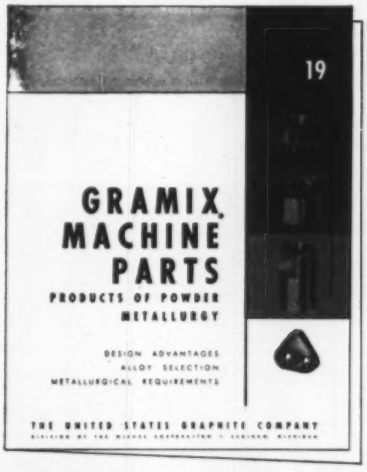
Were you to machine the above parts from bar stock, or were you to finish them from rough castings or forgings, the cost would be considerable, due to their complex shapes. However, these parts—and thousands of others of comparable complexity—are produced economically by the GRAMIX process. GRAMIX parts are die-pressed to the exact shape desired, with tolerances as close as .0005", then sintered. Further machining is seldom necessary, though we often perform a coining operation to give the part a burnished, work-hardened surface. GRAMIX parts can be impregnated with various high-grade oils to furnish self-lubrication at wear surfaces. Alloys available include an extensive variety of brass, bronze, and ferrous types, and our manufacturing process allows us to accurately control the density of GRAMIX parts, assuring a uniform structure. There is probably a component in your product that could be improved with GRAMIX sintered metal parts . . .

Have you given it consideration?

THE UNITED STATES

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

machine parts can be made design requirements . . .

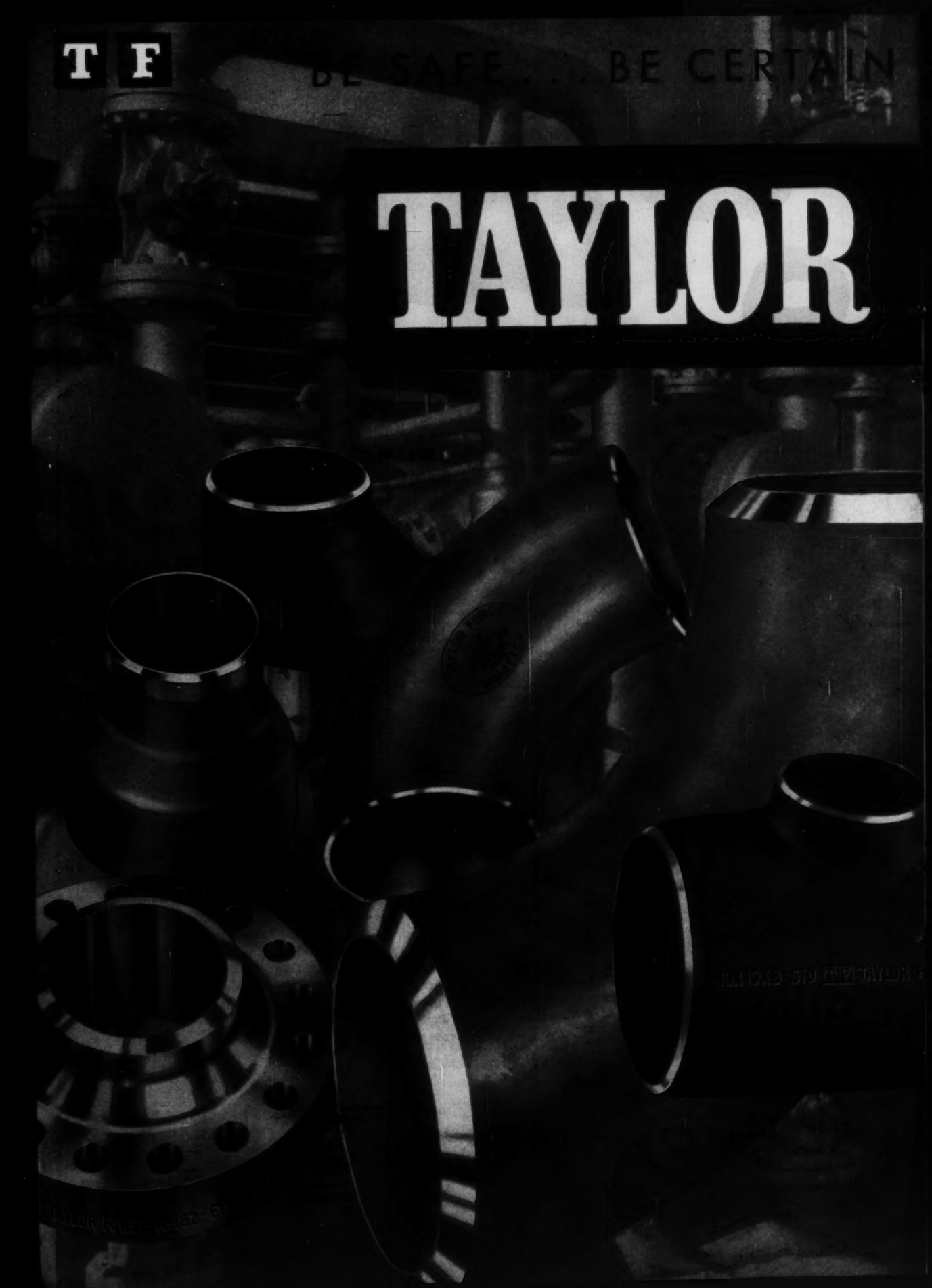


ENGINEERING BULLETIN No. 19

Product engineers specifying materials will find a wealth of design information in this GRAMIX Machine Parts Bulletin. This material is presented in such concise form that questions are quickly and easily answered. A simple chart indicates which alloys—ferrous and non-ferrous—are suitable for different operating requirements. Working sketches show the various design possibilities—radii, helical teeth, dead-end holes, flanges, multiple shoulders—and how they can be utilized to best advantage. Physical properties are presented, and metallography discussed. In all, you'll find Bulletin 19 an ideally simplified guide to a complex subject . . . write now for your copy. 118

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHI


T F
BE SAFE . . . BE CERTAIN
TAYLOR

. . . BE CONFIDENT . . . SPECIFY—

FORGE Welding Fittings and Forged Flanges

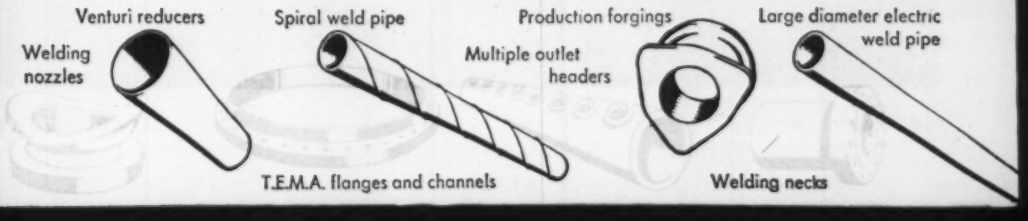
Whether it's a *Carbon Steel* Tee for some ordinary service or an *Alloy Steel* Flange for a high pressure-temperature application . . . whether it's a light wall Stainless Steel WeldELL for corrosion resistance or an extremely heavy one for the most critical nuclear power plant . . . whatever it is you can be safe . . . certain . . . confident . . . if it's made by Taylor Forge. For that name and this marking [T] [F] appear only on products for piping and pressure vessel construction that are truly

TRADITIONALLY DEPENDABLE

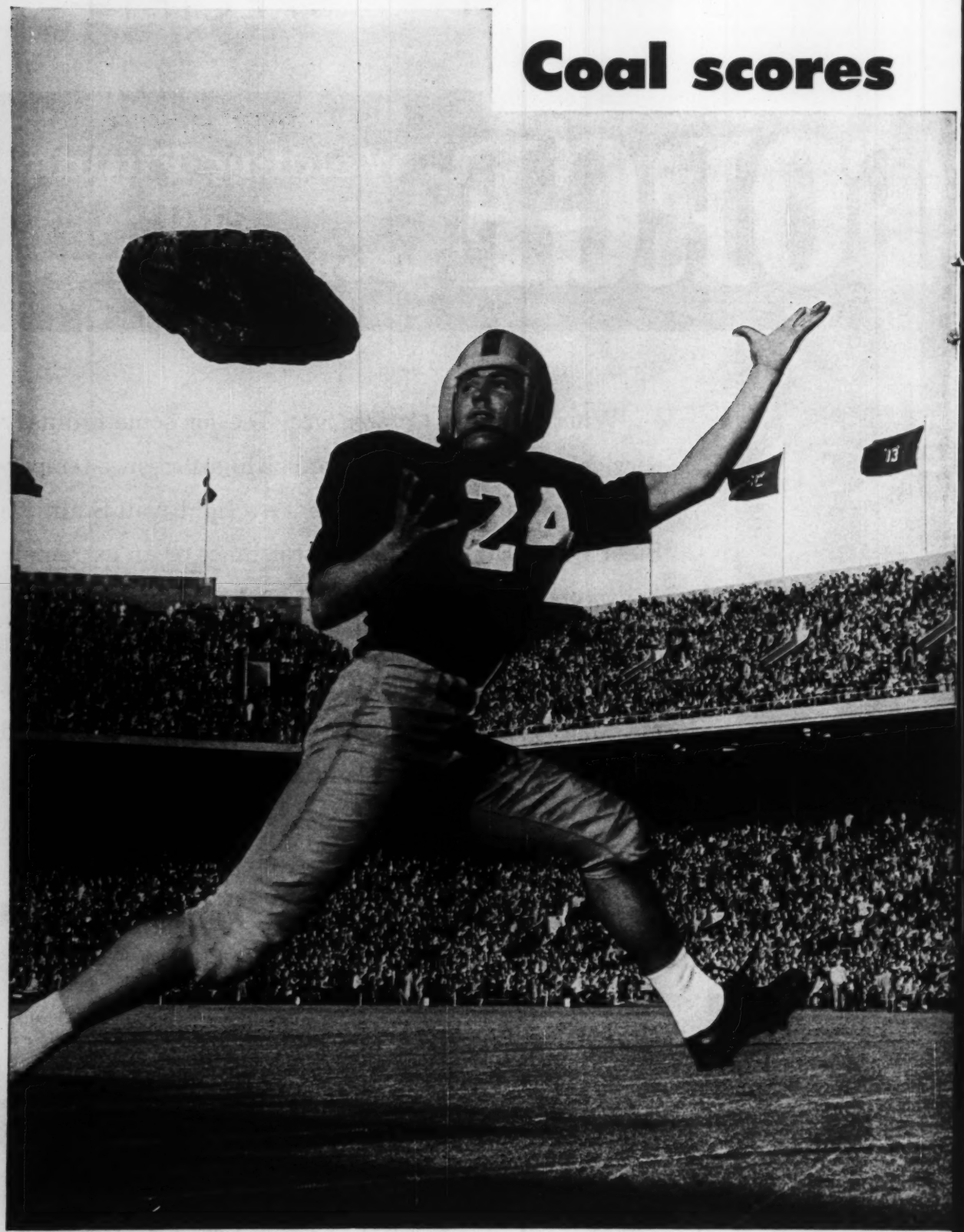
Taylor Forge & Pipe Works

General Offices and Works: P. O. Box 485, Chicago 90, Illinois
Plants at: Carnegie, Pa., Gary, Ind., Houston, Texas, Fontana, Calif., Hamilton, Ont., Canada
District Sales Offices: New York, Boston, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Toronto, Calgary, Montreal.

Call your Taylor Forge Distributor *For prompt, efficient service on the complete Taylor Forge line of Welding Fittings and Forged Flanges, patronize your local Taylor Forge Distributor.*



Coal scores



with Notre Dame

University power plant burns coal for modern steam generation

Enrollment growth and building expansion had put a strain on the power plant at the University of Notre Dame, South Bend, Ind. After careful study—by the consulting firm of Albert Kahn Associated Architects and Engineers, of Detroit—a decision was made to modernize steam facilities and add power generating equipment. Two new coal-fired boilers, a turbo-generator and auxiliary equipment were installed.

Maximum efficiency is achieved through automatic combustion control and complete instrumentation. Today steam is generated *economically.* Another noteworthy result of these innovations has been the *cleanliness* of operation . . . making Notre Dame's power plant a model of good housekeeping.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send coupon below for our case history booklet, complete with data sheets. You'll find it informative.

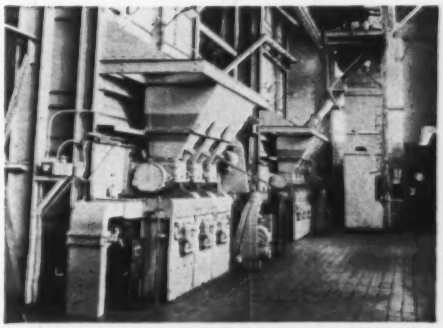
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

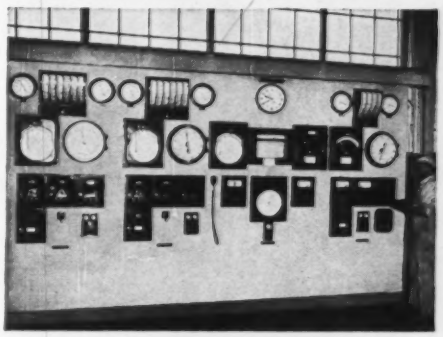
BITUMINOUS COAL INSTITUTE

Department ME-05

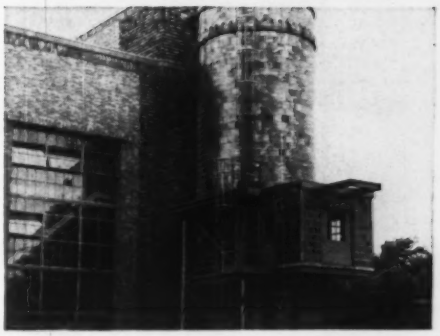
Southern Building • Washington 5, D. C.



Firing aisle shows both Union Iron Works boilers . . . identical 2-drum, bent-tube type with a normal rating of 70,000 lb/hr. These units are fired by Detroit Rotograte Spreader Stokers.

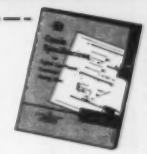


All combustion controls and instruments are centered in this control panel by Hays Corp.



Furnace ash and dust from Prat-Daniel Collectors are conveyed pneumatically to this 50-ton ash storage silo. Rotary dustless unloader assures clean removal of material. Ash-handling system is by United Conveyor Corp.

SEND COUPON FOR YOUR COPY OF "Guide Specifications for Typical Low-Pressure Commercial Heating Plant." This booklet, adaptable for design loads 3,000 to 24,000 EDR steam, contains specifications, drawings and tables on all aspects of a typical heating plant. ME-05



☐ Guide Specifications Booklet ☐ Case histories on larger plants

Name .....

Title .....

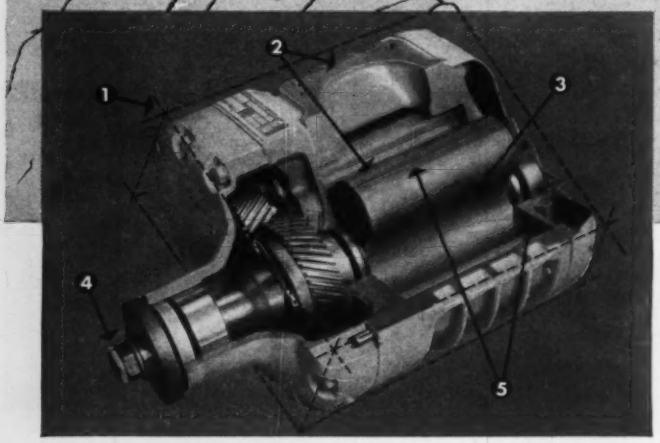
Company .....

Address .....

City ..... Zone ..... State .....

BEST for designing into new air systems . . .

BEST to specify for blower replacements . . .



THERE'S A BIG DIFFERENCE WITH

Miehle-Dexter 3-Lobe Rotary Positive Blowers

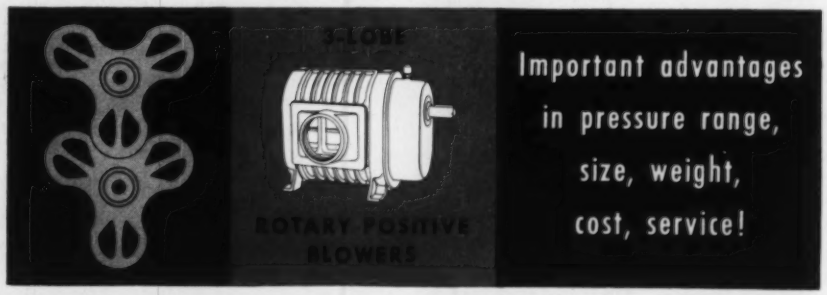
FOR PNEUMATIC CONVEYING

When specifying components for new air systems, or for replacements in existing systems, size and weight considerations are important if maximal space utilization is to be realized. When it comes to size and weight considerations for blowers, none compare with Miehle-Dexter 3-Lobe Rotary Positive Blowers. The advantages of wide pressure and speed ranges, with capacities from 50 to 4000 cfm, make M-D blowers the most efficient for moving materials by air.

① **Smallest Cube** OF ALL ROTARY POSITIVE BLOWERS
② **Heavy Duty** IRON OR ALUMINUM ROTORS AND HOUSING
③ **Wide Pressure Range** 1 TO 14 PSIG SINGLE-STAGE
④ **Wide Speed Range** 1000 TO 4000 RPM
⑤ **Exclusive Formica Wear Strips** ON ROTORS
Patented Rubber Grid Seal ON END PLATE

The performance figures are convincing . . . write today!

Miehle Dexter



Miehle-Dexter Supercharger Division of The Christensen Machine Company, Racine, Wisconsin • Another Product of Miehle-Goss-Dexter, Incorporated

For piping systems that can't be anchored, use ZALLEA HINGED EXPANSION JOINTS

Piping systems like the one in this 63,750 bbl/day catalytic cracking unit, one of the world's largest, at Gulf Oil Corp. Girard Point Refinery, have to be entirely self supporting. The entire cracking unit . . . reactor, regenerator and all connecting lines . . . is suspended in a huge structural steel framework, counterweighted to keep the system in balance, and fitted with Zallea Hinged Expansion Joints to provide vital flexibility plus support for the reactor.

In the 150 ft. air supply line, all thermal movement of the piping is absorbed by angular displacement in three 42" dia. Zallea Hinged Expansion Joints. Start-up air in this line is at 1000°F. Under operating conditions it is delivered at 250°F, 25 psig.

Two 50" dia. Zallea Hinged Expansion Joints in the spent catalyst line carry fluidized cracking catalyst at 950°F, 13 psig.

Since this cracking unit first went on stream, these Zallea Expansion Joints have given completely trouble-free service.

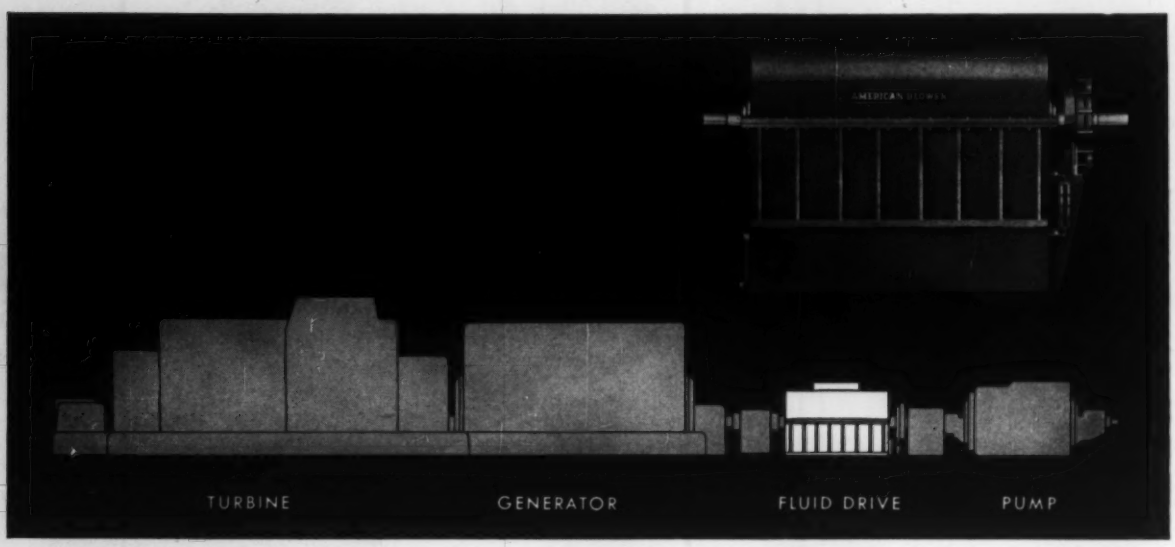
Process piping of any kind can be fully protected with one or more Zallea Expansion Joints. From the complete Zallea line you can select the expansion joint or combination of expansion joints best suited to your particular problems.

Get the complete story in our new 72-page manual. Write today, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 816 Locust Street, Wilmington 99, Delaware.

Zallea expansion joints

Zallea Brothers • Wilmington 99, Delaware

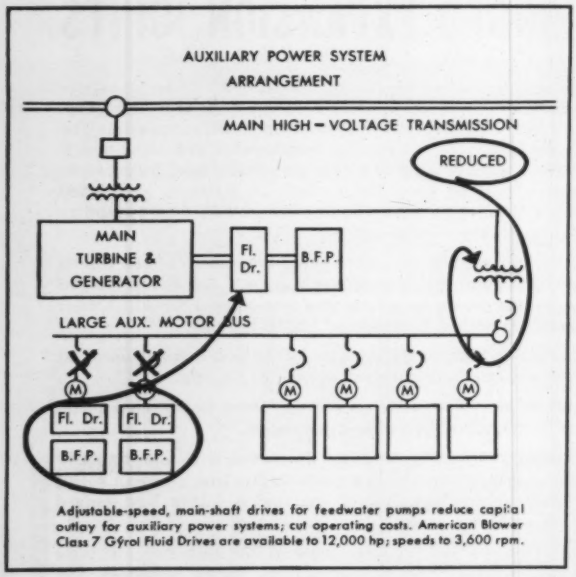
World's largest manufacturers of expansion joints



American Blower *Gýrol*® Fluid Drive lets you:

Take boiler feed-pump power from main-turbine shaft . . . slash auxiliary costs!

Save price of motors, switchgear, conduit and cable. Release more power to consumer lines. Reduce operating costs.



Adjustable-speed, main-shaft drives for feedwater pumps reduce capital outlay for auxiliary power systems; cut operating costs. American Blower Class 7 Gýrol Fluid Drives are available to 12,000 hp; speeds to 3,600 rpm.

Savings of nearly $500,000 are predicted for two new 290-Mw units scheduled for service this year. Both use main-turbine feedwater pumps driven through American Blower adjustable-speed Gýrol Fluid Drives.

Savings are threefold:

1. **Shaft-end pumps eliminate costly electrical accessories necessary for motor-driven feed pumps.**
2. **Auxiliary demands are reduced, so more power can be released to consumer lines.**
3. **American Blower Gýrol Fluid Drive saves power over the entire operating range. It offers adjustable-speed pump control that eliminates wasteful throttling; reduces wear by operating pumps at speeds to fit boiler demands.**

In addition, paralleling of pumps is simplified with Gýrol Fluid Drive. Emergency changeover from operating to standby pump is easily accomplished.

Let an American Blower sales engineer show you how Gýrol Fluid Drive can save power, cut costs . . . improve operating efficiency. Contact our nearest branch office, or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

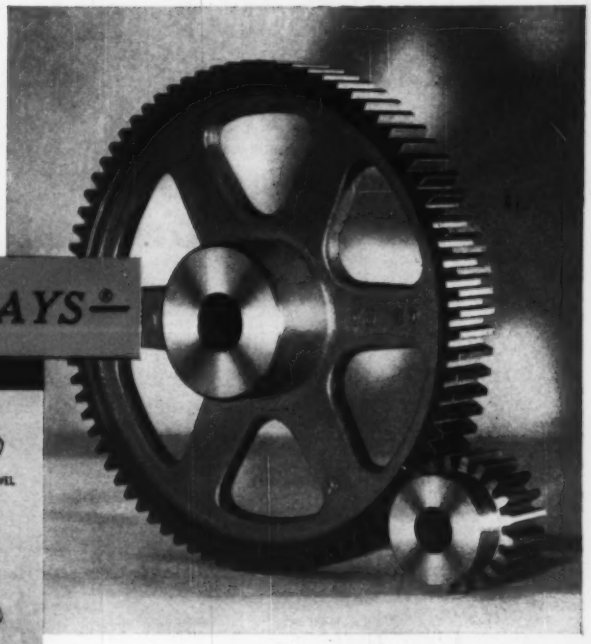
American-Standard Products

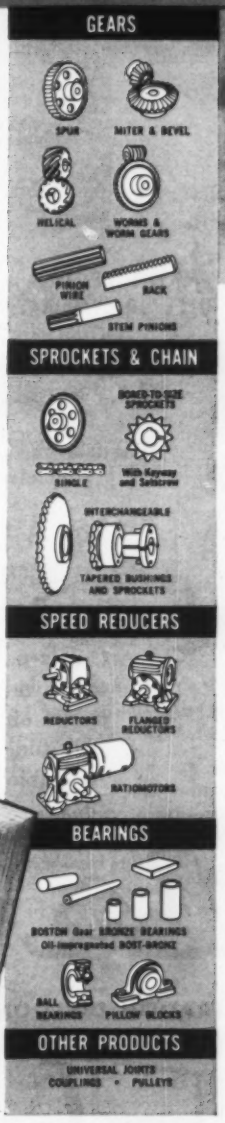
AMERICAN-Standard

AMERICAN BLOWER DIVISION

Plan for extra savings when you design power transmission drives . . . remember

—STANDARDIZATION PAYS—





7124
STANDARDIZED TRANSMISSION PRODUCTS
— OFF-THE-SHELF
— AT FACTORY PRICES

Get CATALOG No. 56 for complete listings. Includes 50 pages of engineering data for drive design.

Design around BOSTON Gear®

When you standardize on BOSTON Gear transmission components, you'll be days and *dollars* ahead in drive design.

You simplify planning. Select all the parts you need from one source—the full range of types and sizes listed in the Boston Gear Catalog.

You save time and expense. Order the parts you need from your local Boston Gear Distributor, and get off-the-shelf delivery—from stock—at factory prices.

You get top-rated performance. Compare and see why cost-wise buyers agree that Boston Gear products set the highest quality standards.

Why wait (and pay more) for parts "made-to-order?" Your Boston Gear Distributor is fully qualified to help you get the maximum benefits from standardization—in lower costs, in simplified servicing. Boston Gear Works, 66 Hayward St., Quincy 71, Massachusetts.

CALL YOUR BOSTON Gear DISTRIBUTOR

For nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

WHY YOU SHOULD SPECIFY

Curtis

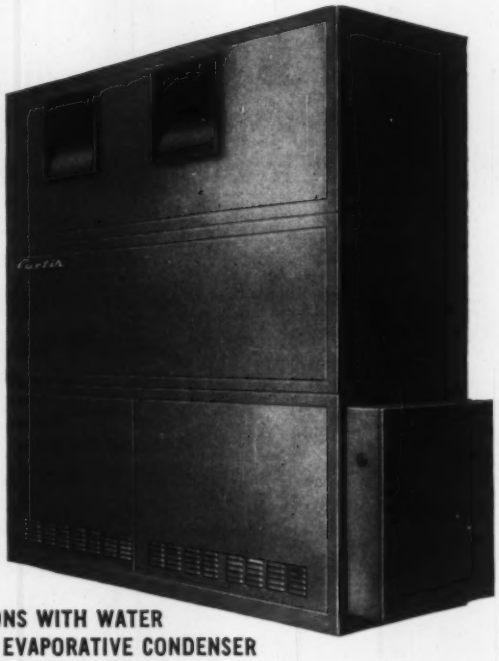
PACKAGED AIR CONDITIONING

INSTALLATION EASIER: Line assembled at the factory —eliminates expensive field labor.

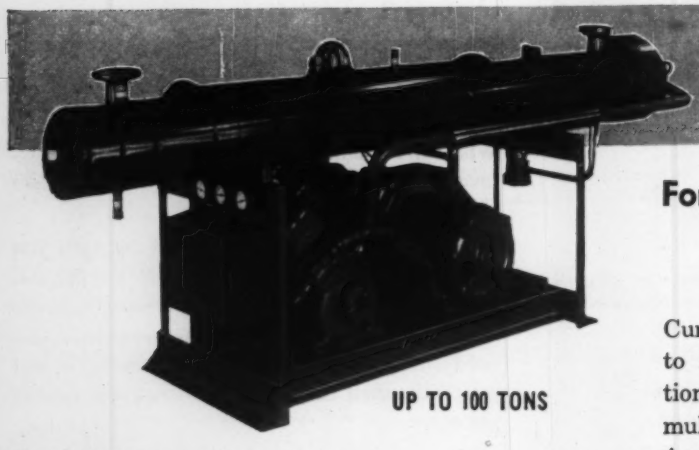
PERFORMANCE KNOWN: Curtis units are run-in at the factory and guaranteed to deliver their rated tonnage. Assures a BALANCED SYSTEM.

SUPERIOR EQUIPMENT: Long life, quiet, trouble free, economical operation.

DELIVERY ON TIME: Curtis can meet your delivery requirements, a decided advantage over multiple supplier delivery promises!



UP TO 50 TONS WITH WATER COOLED OR EVAPORATIVE CONDENSER



UP TO 100 TONS

PACKAGED LIQUID CHILLERS

For Air Conditioning Process Cooling Refrigeration

Curtis packaged liquid chiller lends itself to a widely diversified field of applications—air conditioning, refrigeration and a multitude of process cooling procedures. Available in capacities up to 100 tons.

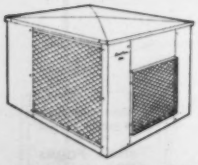
REMEMBER, you can count on

Curtis

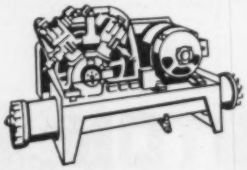
OUR 104TH YEAR

MANUFACTURING COMPANY • REFRIGERATION DIVISION

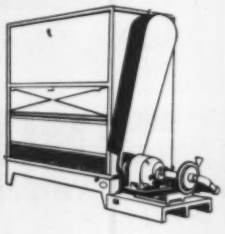
1940 Kienlen Ave., St. Louis 20, Mo.



Air Cooled Air Conditioning Units, 3-5-7½ tons. Residential and commercial application.



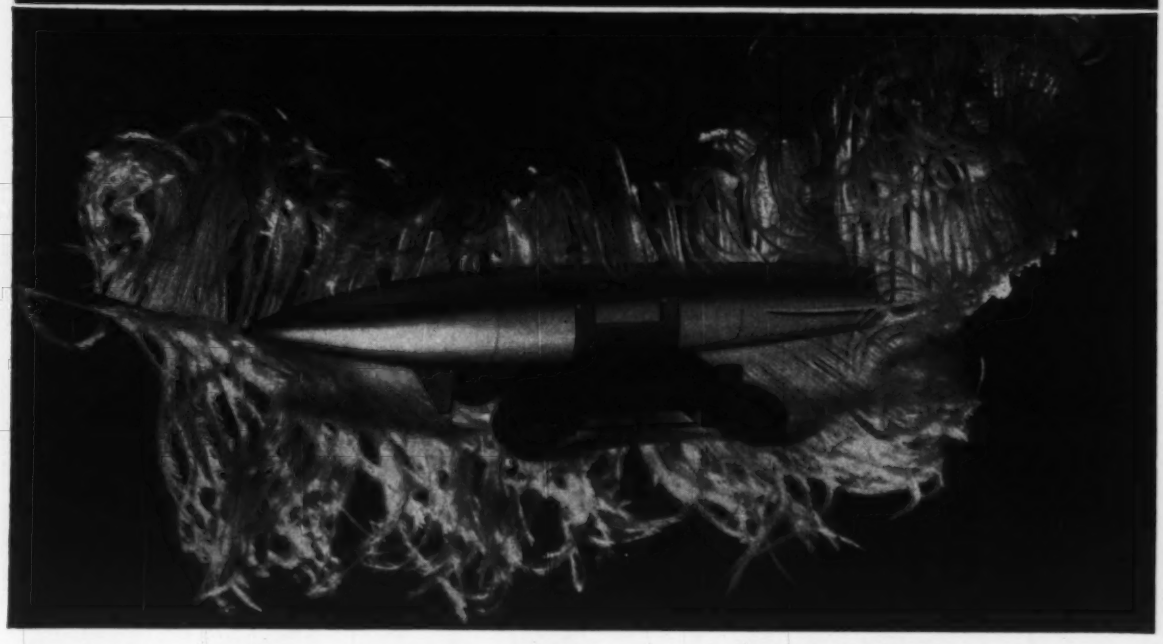
Condensing Units up to 100 tons.



Cooling towers and evaporating condensers, air handling units to match.

C-33

missiles get a "feather-bed ride" with Houdaille rotary shock absorbers!

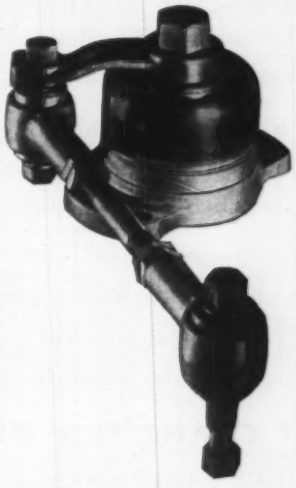


On-the-ground transportation of delicate missiles is a tricky job. Sensitive components and accurate adjustments must be protected from jolts and vibration. That's why manufacturers of missile trailers specify and use Houdaille Rotary Shock Absorbers.

On the roughest terrain, Houdaille Rotary Shock Absorbers provide positive vertical, longitudinal and lateral control. An *exclusive* external adjustment permits compensation for changes in road conditions. Houdaille Rotary Shock Absorbers never need lubrication—can't deteriorate from water, dirt or corrosion. Result: Many thousands of miles of rugged, dependable service — with virtually *no maintenance*.

What about *your* requirements? If you want protection of valuable lading, long, trouble-free life and absolute dependability...then you need Houdaille Rotary Shock Absorbers.

WRITE FOR TECHNICAL FOLDER giving complete details and performance data.



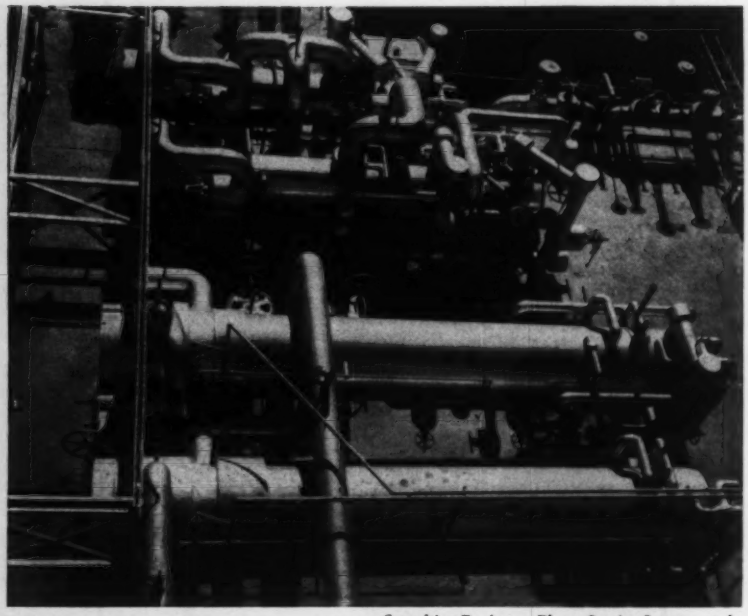
Houdaille Engineers *and production facilities are ready to serve you. ROTARY SHOCK ABSORBERS are available in a wide range of sizes. LINEAR and OTHER HYDRAULIC damping and snubbing devices can be custom-engineered for special damping control requirements in missile transportation.*

HOUDAILLE QUALITY PRODUCTS

Houdaille Industries inc.

Specialists in vibration control and hydraulic applications

BUFFALO HYDRAULICS DIV. • 537 E. Delavan Ave., Buffalo 11, N. Y.



Consulting Engineers, Ebasco Services Incorporated

The modern, efficient equipment shown here was designed and built by the Yuba Heat Transfer Division for the Collin Station of the Texas Power & Light Co. Serving a 110,000 KW turbine are five Yuba feedwater heaters, of which four are shown here. Two high-pressure heaters are designed for 2600 psi on the tube side with 6500 and 6750 sq. ft. of surface. Three low-pressure heaters are designed for 400 psi on the tube side and have 2850, 3165 and 4670 sq. ft. of surface.

Yuba designed and built the first all-welded feedwater heaters, in service for the last year and a half. The weld technique was used in the tube bundles, shells and Multilok Closures. These all-weld heaters have been so successful they have started an industry trend.

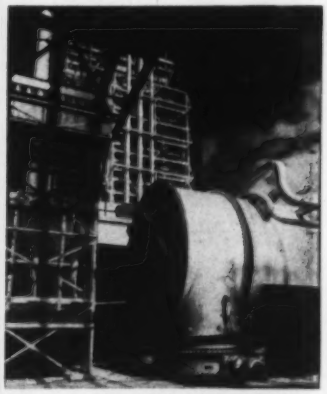
In the manufacture of condensers, Yuba is building units having 165,000 sq. ft. of total surface. The designs are readily adapted to condensers of even greater capacity as required for larger turbines.

Yuba evaporators have achieved boiler make-up water purity of less than .2 ppm. Yuba can *guarantee* purity of .25 ppm solids content per 3000 ppm shell concentration.

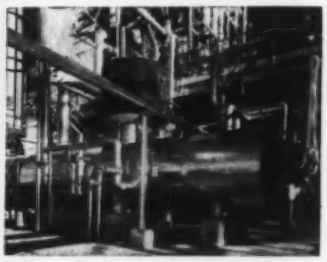
Engineering accomplishments such as these keep the power industry up-to-date. There's progress in power through progress in heat transfer equipment.

YUBA

EQUIPMENT will still be UP-TO-DATE TOMORROW because IT'S AHEAD TODAY



Twin-unit surface condenser has 90,000 sq. ft. of surface. Operates at 26.52 inches of vacuum with oxygen content in the condensate less than 0.01 cc per liter.



Bubble-tray evaporator produces 34,000 lb./hr. of vapor well below 1.0 ppm total solids with 3000 ppm concentration.

YUBA HEAT TRANSFER DIVISION

HONESDALE, PENNSYLVANIA
NEW YORK SALES OFFICE: 530 FIFTH AVENUE
REPRESENTATIVES IN PRINCIPAL CITIES

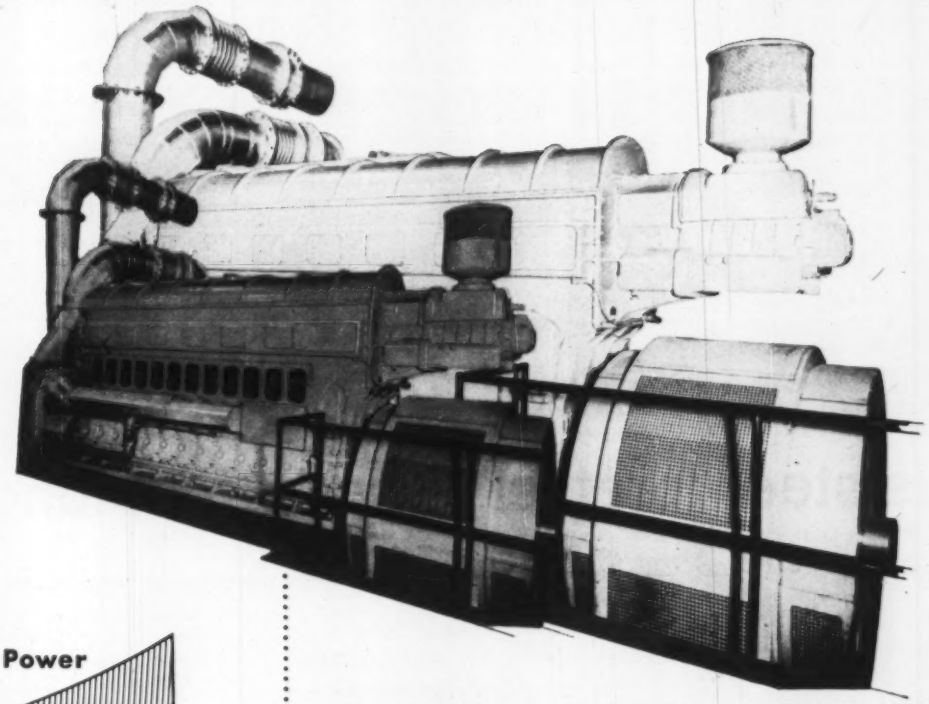
Other Yuba Divisions
Adsco Division, Buffalo, N. Y.
California Steel Products Division, Richmond, Calif.
Yuba Manufacturing Division, Benicia, Calif.

YUBA

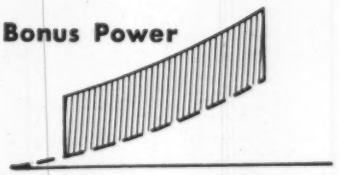
STEAM SURFACE CONDENSERS
EVAPORATORS
STEAM JET REFRIGERATION
STEAM JET AIR EJECTORS
FEEDWATER HEATERS
BAROMETRIC CONDENSERS

YUBA CONSOLIDATED INDUSTRIES, INC.

50% More Power with Fairbanks-Morse TURBOCHARGED OPPOSED-PISTON DIESEL

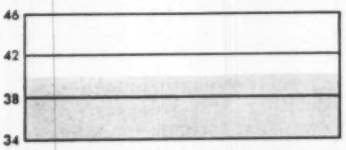


Bonus Power



Auxiliary blower is automatically declutched at loads above approximately 1/3 rating to deliver more usable power at the flywheel.

Increased Thermal Efficiency



Turbo-charged Fairbanks-Morse Model 38TD-8 1/8 Opposed Piston Diesel is approaching a new high of 40% efficiency.

New Efficiency...New Power...New Fuel Savings For Marine and Stationary Applications

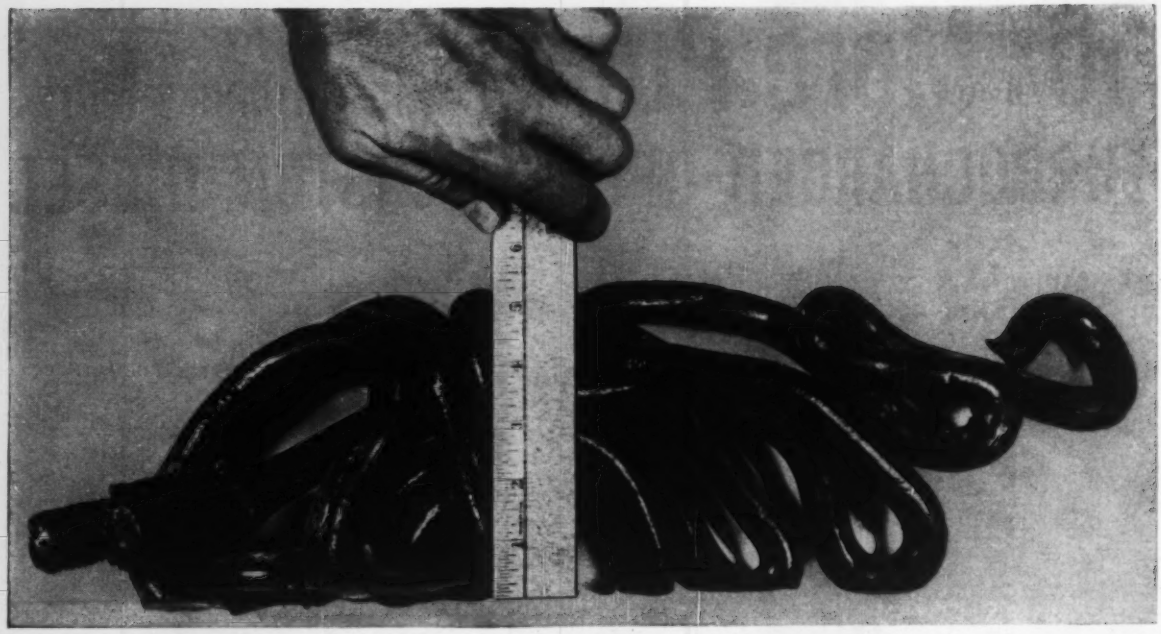
The industry's most compact, simple, and dependable diesel—the Fairbanks-Morse Opposed Piston—*is now turbo-supercharged!* Fuel savings from 5% to 10% are effected on full-load operations—even more on part loads. And 50% more power has been added. At 900 rpm, for example, it is conservatively rated at 300 hp per cylinder. Yet it occupies vitually the same space as the non-supercharged version...weighs only about 8% more. Look at the advantages in this usually low size and weight per horsepower.

Stationary installations—save on foundation and building costs.
Commercial marine use—more power, speed, fuel and cargo capacity.
Portable operations—save with most compact power available today.

Greater power is available at higher altitudes because the engine is less sensitive to atmospheric pressure. Oil and water cooling requirements show almost no increase at the higher output. It's all possible with careful matching of system and engine. Divided manifolds permit use of exhaust pulses with no pressure cancellations. Engine-driven auxiliary blower provides scavenging air up to ⅓ load—declutches above this figure to make additional power available at flywheel. For full information write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

DIESEL AND DUAL FUEL ENGINES
DIESEL LOCOMOTIVES • RAIL CARS
ELECTRICAL MACHINERY • PUMPS
SCALES • HOME WATER SERVICE
EQUIPMENT • MAGNETOS



This steel "pretzel" was 14 feet long!

Down near Caprock, New Mexico, they're still talking about it . . . the nickel alloy steel sucker rod that squashed into 18 inches.

It took an accident to demonstrate real toughness.

The sucker rod, a long shaft connecting power at the surface with a piston thousands of feet below, was operating rhythmically. Its reciprocal motion brought up oil in rich spurts.

Suddenly, part way down, the well casing broke, trapping the sucker rod. Fourteen feet of rod were quickly crammed into 18 inches. But despite violent twists the sucker rod *didn't break!* See for yourself!

Nickel alloy steel provides toughness... plus fatigue resistance

Stresses on sucker rods from the pumping motion are high, and fatigue life must be extended as far as possible even in corrosive wells. That's why this one was made of AISI 4820 steel – a high-strength nickel alloy steel containing 3.5% nickel and .25% molybdenum.

It's a quenched and tempered steel. Normally a carburizing grade, 4820 specially quenched and tempered gives excellent toughness along with through hardness and relatively high strength.

Typical mechanical properties are:

Ultimate strength	120,000 psi
Yield strength	110,000 psi
Elongation	25% in 4 x diam.
Reduction of area	68%
Brinell hardness	241
Izod impact	90 ft. lbs.

We don't know of many better illustrations of the toughness and ductility of high strength nickel alloy steels than this one.

At any rate, down near Caprock, New Mexico, they're still talking about it.

If you'd like to know more about high mechanical properties of Nickel Alloys Steels . . . their strength, toughness, ductility and resistance to corrosion fatigue, for example, send for "The Properties of Heat Treated Wrought Nickel Alloy Steels."

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL ALLOYS PERFORM BETTER LONGER

MECHANICAL ENGINEERING

VOLUME 80 • NUMBER 5 • MAY, 1958

Four + Eight = Sixteen

Addition wrong? Arithmetically, yes—but publicationwise, no! Reason: ASME is revamping its publication plan for Transactions of the ASME. This new plan, which will commence in January, 1959, takes the following shape: The existing eight issues of Transactions will be split into a series of three quarterlies—12 issues in all. These, plus the established quarterly, *Journal of Applied Mechanics*, which has been published for 24 years, will make a total of 16 issues per year instead of the current 12.

The three new journals will cover Basic Engineering, Power Engineering, and Industry Engineering.

Purpose of this radically new publication plan is to categorize, in so far as possible, the technical output of ASME into more usable packages. In addition, the volume of material published in Transactions has nearly doubled since 1945, making it cumbersome to handle within eight issues.

Here is the proposed subject breakdown, based on the Professional Divisions of ASME, and how they would fit into the three new journals:

The *Journal of Basic Engineering* will include papers of the Heat Transfer, Hydraulic, Instruments and Regulators, Lubrication, and Metals Engineering Divisions plus material from appropriate ASME Research Committees.

The *Journal of Power Engineering* will cover Fuels, Gas Turbine Power, Nuclear Engineering, Oil and Gas Power, and Power Division papers, and any suitable ASME Research Committee papers.

The *Journal of Industry Engineering* will contain papers from the Aviation, Machine Design, Maintenance and Plant Engineering, Management, Materials Handling, Petroleum, Production Engineering, Process Industries, Rubber and Plastics, Railroad, Safety, Textile, and Wood Industries Divisions, and applicable Research Committee material.

The foregoing titles are tentative and subject to change.

While some added features are contemplated in the new quarterlies, the basic concept of the existing Transactions will be retained; that is, only high-quality permanent-interest or reference-type papers will be accepted for publication.

The Publications Committee, since 1955, has been grappling with the problem of splitting the Transactions into suitable packages. Early this year, at the request of the Committee, the Editorial Department proposed the foregoing scheme which was accepted by formal action of the Publications Committee on February 26. The Committee referred its action to the Board on Technology for approval on the following day. The Board heartily endorsed the new plan and voted to recommend to the Council that the plan be adopted. At its meeting on April 4, the Executive Committee of the Council voted to accept the new packaging plan.

Concurrently, rising costs and increased volume (60 per cent in printing since 1945 plus the added fact that the volume of material has nearly doubled since then) dictate that a greater income from Transactions is necessary.

Hence the Publications Committee, the Board on Technology, and the Executive Committee of the Council, after study of costs, volume of material, and anticipated increases in both, set subscription prices of the individual quarterly journals at $5 each per year to members. The combined subscription price for the four quarterly journals was established at $15 per year to ASME members. Nonmember rates are double the member rate.

Thus, ASME embarks on a new publishing venture which it is hoped will meet with the approval of the membership and at the same time improve the publication services offered by ASME to its members.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

Editor Emeritus, GEORGE A. STETSON

"The problem is to **Sharpen the Truth** into

By Richard M. Nixon, Vice-President, The United States of America

With the race to outer space temporarily tied, numerically at least, at two each, this would seem to be an appropriate time to put the dramatic events of the past six months in perspective. What are the lessons of the Sputnik era for the American people?

First, we must acknowledge that some of the initial extreme reactions were not supported by the facts. These conclusions, which some jumped to because of the shock of finding the United States behind in a major new area of progress, will not stand examination: (*a*) That the United States is now weaker than the Soviet Union; (*b*) that our scientists are inferior; (*c*) that our education system is a failure.

Let us recognize at the outset these facts: (*a*) The United States with its free world allies is militarily stronger than any potential aggressor in the world. (*b*) United States scientists are the equal in quality of those of any other nation. (*c*) Our education system has its weaknesses, but over-all it provides probably a better education for more people than is available in any other nation in the world today.

Our National Reactions

Let us turn now to some of our national reactions which were justified and healthy, in view of the challenge which was presented to us.

We have accelerated our ballistic missiles program. We are developing plans to reorganize the Department of Defense so that it can better deal with the problems inherent in the new dimensions of modern warfare. We have stepped up our program for the exploration of outer space. We have recognized the need for training more scientists and for improving our educational system.

These reactions were understandable and constructive. They do not need extended discussion. On the other hand, there are some less apparent, but in the long run possibly even more important, lessons we should learn. Among these we must try to provide for the nonscientists the insight and understanding with respect to science which we have historically sought to give to all of our citizens in the field of humanities.

One of our major needs is to develop a wider appreciation of the importance of the long-range benefits of basic research. The bad habit of coming forth with huge sums and crash programs only when outside events generate a sense of urgency is dangerously irresponsible. Basic research cannot be carried out on a crash basis.

We must not permit a few successes to soothe our injured pride and lull us again into complacency and a false sense of security.

Agency for Space Program

Turning now to a very practical question: What type of government agency should have the primary responsibility in the development of our outer space program?

There can be only one answer. We must not be limited by military needs or military thinking in exploring outer space, just as we are not so limited in developing nuclear energy.

Science is one of the great new frontiers of our time. Like the frontiersman, the scientist explores the unknown for the sake of adventure as much or more than for the sake of gain.

We must be motivated in developing our space program not by fear, but by the positive desire to explore one o the most challenging frontiers science and mankind have ever faced. The best way to insure that the scientist in this field makes the greatest contribution to the national welfare, including our missile program, is to keep him free from the requirements of immediate military necessity.

Who will win the military ballistic missiles race? The answer, of course, to this question is that in this race there can ultimately be no winners, only losers. Because it has become so obvious as to be almost trite to observe that ballistic missiles combined with nuclear warheads spell destruction of civilization as we know it.

The greatest lesson of the Sputnik era, therefore, is in effect a solemn warning—find the road to peace or be destroyed.

The unqualified dedication of the government and people of the United States to the cause of peace cannot seriously be questioned by anyone who knows our record in international affairs. But some of our friends, as well as our opponents, have questioned whether our policies are designed to further that objective. Let us examine some of the criticisms that have been made.

Why do we not accept the Soviet proposal for stopping atomic tests?

Stopping tests is not in itself going to reduce the danger of war. The types of weapons already in production are adequate to carry out their mission of massive destruction. That is why control of production as well as tests of nuclear weapons, as the United States has proposed, is the only formula which goes to the heart of the problem.

The same considerations are involved in the United States' position on disarmament.

There is no question as to our desire to enter into a disarmament agreement. The problem is securing an agreement that is enforceable, because an agreement without adequate inspection provisions, which one party might honor and the other might not, would seriously and perhaps fatally increase rather than reduce the risk of war.

The Summit Conference

The American position on the summit conference fits into the same pattern.

A summit conference which failed would increase rather than reduce international tensions. A conference which is not preceded by adequate preparatory discussions is doomed to fail.

The Soviet leaders are blocking the road to the summit by insisting on conditions for a conference which they

Based on an address delivered at the All-Congress Banquet of the 1958 Nuclear Congress, Chicago, Ill., March 17–21, 1958.

a weapon as effective and devastating as the Soviet lie!"

know and we know will assure its failure. They can prove their dedication to peace by agreeing that preparatory meetings should discuss the substance as well as the form of proposed agenda items.

It is the Soviet Union, not the United States, that has the blood of Hungary on its hands. Our sole aim in war and peace has been and is to assure the right of all nations to be free from armed aggression and foreign domination.

We recognize that the freedom and independence of others are the best guarantee of the freedom and independence of the United States. We are wholeheartedly supporting every international organization devoted to the cause of peace. Our defense forces are designed for and will be used only to stop aggression, not to launch it.

Our Record in Atomic Power

Our record in the field of atomic power is one of the really exciting chapters in the history of man's quest for world order based on international co-operation and understanding. When we had a monopoly on the atom, every nation on earth knew that we would never use our awesome and unquestioned military superiority for aggression or for international blackmail. We offered to share peaceful benefits of this new source of energy with all other nations. As a result we have agreements with forty nations for peaceful development of the atom.

Why, then, is there any question about the devotion of the American people and government to the cause of peace?

It is a happy but sloppy cliché that our record speaks for itself. But our record does not speak for itself. It is cunningly twisted by devious masters in the art of propaganda. It is warped and distorted to their purposes. The less sophisticated peoples of the world are told that we build thermonuclear bombs; that our planes endanger lives by carrying deterrent weapons, even though that is all that confines Soviet aggression; that our weapons tests threaten world contamination even though our tests are now primarily designed to remove the dangers of contamination.

Unfortunately, this is what much of the world believes. Even in the advanced countries that comprise western civilization this propaganda terror is having its effect.

Communist Propaganda

What can we do about it?

We cannot use the communist technique of the measured lie. The problem is to sharpen the truth into a weapon as effective and devastating as the Soviet lie.

This task cannot be done entirely by government, even though we were to enlarge our information agencies to match those of the Soviet Union.

One of the most effective ways is through expanding person-to-person contact and people-to-people understanding. I speak not only of those exchanges that are arranged and financed by government. Even more effective are the activities abroad of some of the people in this audience—technicians, engineers, scientists, representatives of private industry and foundations.

As a government and as a people we must wage peace not only in what we do but in what we say—the exploration of outer space for peaceful rather than military purposes; the development of nuclear power for peace rather than war; airpower for peace; science for peace.

All of these concepts must be reiterated again and again if we are to present to the world a true picture of American objectives in international affairs.

Our military power must be maintained at an adequate level to deter aggression. But here the fact of our power will speak for itself. Let us keep our powder dry, but the less we talk about it, the better. We might well practice more restraint in boasting about what our next exploit will be and when we will do it. A big achievement speaks for itself. It does not need a big buildup.

As those attending this conference are acutely aware, man's discovery of nuclear power can prove to be the greatest force for peace in world history.

Power for Peace

There is the negative force created by the awful power of nuclear weapons which makes war less attractive to a potential aggressor as an instrument of policy. But more important in the long run are the positive forces which have been and will be unleashed by the development of nuclear power for peaceful purposes.

We have already harnessed the energies released by the splitting of the atom. Even now there are areas of the world where nuclear power plants may be the most economical source of power. In a decade or two we hope that literally unlimited power sources will be at our disposal.

Obviously, if we contain, as seems possible, the even greater power of the fusion reaction, the limits of our achievement are beyond calculation. From the physical standpoint, at least, man will be the undisputed master of his universe. We can, for the first time in world history, wage a winning war on poverty and destitution, on hunger and disease.

In such an age the economic reasons for war will be removed—because there will be energy enough to produce for the needs of all.

I do not suggest that the nuclear age can or will solve all the problems of mankind. World peace and even industrial peace depend on many factors.

Want and hunger are not the only causes of discord among men. But they rank high among the conditions that cause dissension and war.

If we can bring prosperity to the world, the chances for world peace would be immeasurably enhanced.

"We cannot use the communist technique of the measured lie...."

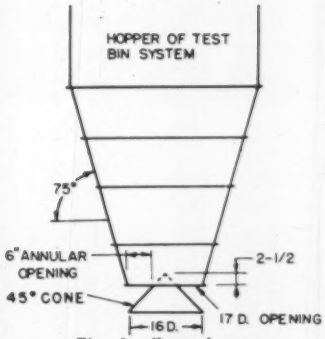
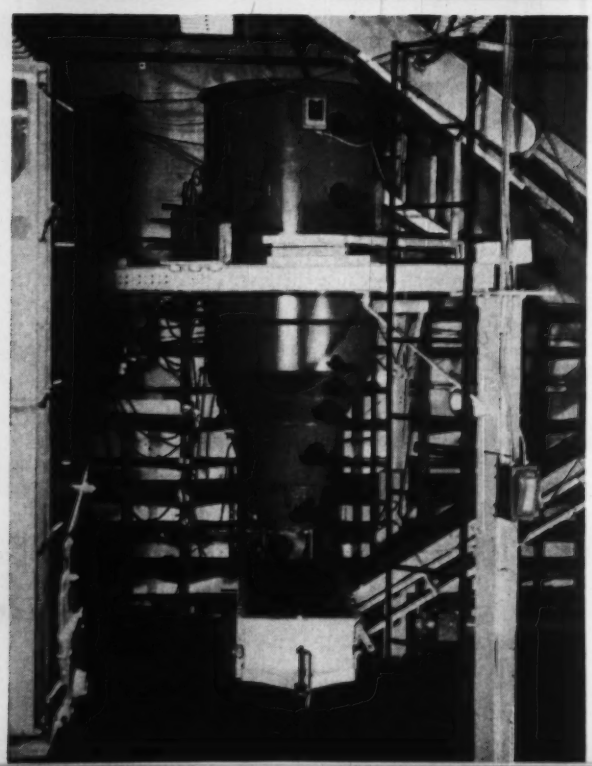


Fig. 3 Central-core flow retarder. This experiment proved that with the central core retarded, full movement of the coal at the bin walls would result. However, the external conical surface made coal withdrawal impractical.

Fig. 1 The BCR laboratory installation. Coal was handled to and from the test bin by means of flight conveyers. The bin itself was a vertical section, of 3-ft diam and 4-ft height, to which additional sections — cylindrical or conical — could be bolted.

Fig. 2 Close-up of the bin. Combinations of vertical and 45, 60, and 75-deg hoppers were possible, with five bottom-discharge openings, between 8½ and 20-in. diam. Total capacity was 2800 lb of ¼ to 0-in. coal, containing 10 per cent total moisture.



Flow of Coal

Success of automatic coal-burning equipment depends on a uniform flow of coal. Tests have led to a device to control the flow of bulk solids from bins.

By F. D. Cooper[1] and J. R. Garvey,[2] Mem. ASME
Bituminous Coal Research, Inc.,
Columbus, Ohio

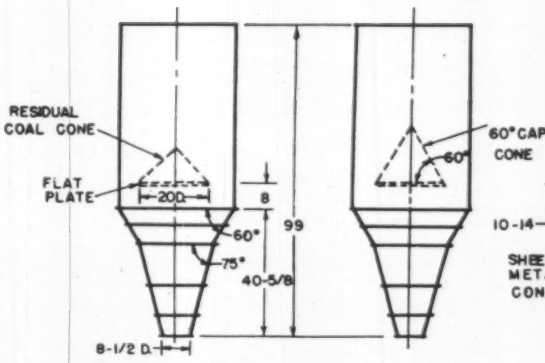


Fig. 4 Experiment with a flat plate within the bin. Studies were made using 17, 20, and 24-in. diam circular plates, mounted 5 and 8 in. above the juncture of the vertical and sloping walls. The 20-in. plate at 8-in. elevation gave the best performance.

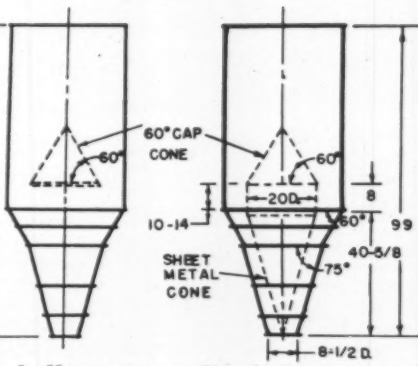


Fig. 5 Here, a metallic cap cone has been added to the circular plate, giving the same coefficient of friction as the bin walls. Result: Reliable flow from the vertical bin to the sloping hopper. But coal still tended to jam in the hopper.

Fig. 6 Cap cone, metal cylinder, and inverted cone. This design proved ineffective. Coal wedged between the cylindrical section and the walls of the bin. The cylindrical section had to be abandoned.

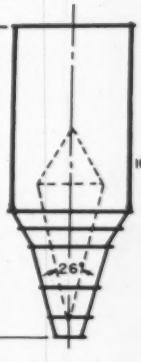


Fig. 7 Cap cone and inverted cone. This combination was immediately successful. Central core movement could be eliminated, and the goal of low, steady pressure on the hopper walls could be achieved. Flow was reliable, and coal passing through the outlet was loose.

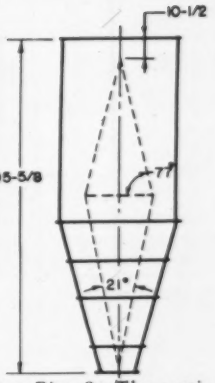


Fig. 8 The optimum design. With previous designs, there had been some residual coal held by the 60-deg sloping sections. Now, with the cap cone and inverted cone, a simpler hopper could be tried. This configuration handled ¼ to 0-in. coal containing 15 per cent surface moisture.

THE controlled discharge of coal, or other bulk solids, is vital to the automation of any "storage bin to processing equipment" sequence. Most bins are still designed by rule-of-thumb methods. Flow performance is poor. It was decided that a study of events in a bin preceding, during, and immediately following inflow and outflow might be fruitful.

Test Apparatus

The test apparatus illustrated in Figs. 1 and 2 was constructed at the BCR laboratory in Columbus, Ohio. The interior surfaces of the carbon-steel test bin were not smoothed, and the normal roughness of the construction, later increased by rust and fine-coal adhesion, was present.

Water additions to the coal were made by spray nozzles located above the conveyers, and provision was made for sealing the surge bin so that uniform wetting of the coal could be accomplished by allowing it to set for a period of several hours. After discharge from the test-bin outlet, coal was handled by various methods, including free fall to the laboratory floor, hand scraping on an inclined plate, a flight conveyer, and a convergent volumetric feeder. Coal could be fed to the test bin at rates between 100 and 950 lb per min, with a free fall from above the top of the bin of 10 ft maximum and 2 ft minimum.

An extensive series of tests was conducted using the test apparatus as a conventional storage system with 45, 60, and 75-deg hopper bottoms and various discharge-opening diameters. The information obtained during these tests merely confirmed what the authors and others had observed in full-scale plant operations.

From the nearly 150 tests run, it was concluded that poor flow performance of conventional storage bins is due to the presence of a central-core movement responsible for rat-holes and high pressures on and coal adhesion to the hopper walls. The solution to reliable solids flow is a cheap means to eliminate the central core and to provide an environment of low, steady pressures on the hopper walls, thereby obtaining plug-type motion through the entire bin and hopper.

Needed: A Bin-Discharge Device

In an effort to eliminate the central core movement and to provide the needed low, steady pressures on the hopper walls, a number of bin wall configurations and internally mounted devices were tried.

Central Core Flow Retarder. The first attempt was the device illustrated in Fig. 3. Tests proved that, if the central core could be retarded, full movement of the coal at the bin walls would result and improved flow would be achieved. However, continuous withdrawal of the coal from the external conical surface would be impractical under field conditions.

Flat Plate. Using the test-bin configuration found to be most satisfactory during the testing of a conventional bin, namely, the 36-in-diam vertical section with the combination 60 and 75-deg sloping sides, a series of tests was conducted using flat circular plates supported above the juncture of the vertical and sloping walls.

Fig. 4 shows the arrangement. The 20-in-diam plate

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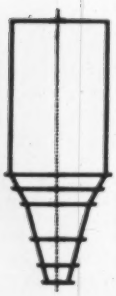
Contributed by the Fuels Division and presented at the ASME-AIME Joint Fuels Conference, Quebec, Canada, Oct. 10-12, 1957. Condensed from ASME Paper No. 57—FU-2, "Flow of Coal in Bins."

Flow of Coal



at 8-in. elevation gave best performance, enabling handling of coal containing up to 10 per cent surface moisture. It was observed that flow of coal through the complete test bin was divided into two parts: (*a*) Flow from the vertical section to the sloping hopper section; and (*b*) flow through the hopper section and out the discharge opening. While the use of the 20-in-diam circular plate gave improved flow from the hopper section through the outlet due to reduction in pressures, there was difficulty in the passage of coal from the vertical section to the hopper section.

Vertical Cap Cone. To improve the flow, the use of a 60-deg sloping cone with 20-in-diam base was tried, as shown in Fig. 5. Tests showed that, owing to the uniform coefficient of friction between the coal flowing over the cone and the coal flowing along the bin walls, reliable flow could be obtained from the vertical bin section to the sloping hopper section. Coals with moisture content up to 12 per cent surface moisture could be handled through the vertical section. However, jamming of the coal occurred in the hopper section, again giving unreliable flow through the outlet.

Cap Cone With Lower Cylinder and Inverted Cone. To prevent the repacking of coal below the cap cone, a series of tests was conducted using the 20-in-diam cone to which was attached a cylinder and inverted cone as shown in Fig. 6. Tests with cylindrical sections of 10 and 14-in. heights proved ineffective and resulted in wedging of the coal between the cylinder surface and hopper wall.

Successful Basic Form

Cap Cone and Extended Inverted Cone. The next modification of the bin was the installation of the 60-deg cap cone of 20-in. diam and an inverted cone extending from the base of the cap cone to within 2 in. above the outlet opening, as shown in Fig. 7. As soon as testing was started on this idea, it became apparent that the basic design goal—to enable elimination of the central core movement and to provide an environment for low, steady pressures on the hopper walls—was being approached. With the bin design shown, it was possible to obtain reliable flow with $^1/_4 \times 0$-in. coal containing as high as 12 per cent surface moisture at flow rates up to 2500 lb per min through an $8^1/_2$-in-diam outlet opening.

Flow of coal from the vertical bin section to the sloping bin section was accompanied by a rolling effect of the coal at the hopper walls. The flow of coal through this section was essentially plug-type flow. The coal passing through the hopper section into the outlet was loose and fluffy, and no changes in pressure in the hopper section occurred when the loading above the hopper section was increased.

Modification and Application

The development of the internal-cone designs evolved about the use of a combination 60-deg and 75-deg hopper bottom, because this particular configuration had given most successful results without cones installed. With the use of appropriate cones this type of bin gave good flow characteristics, but some residual coal remained after emptying, this coal being supported by the 60-deg sloping sections.

The 75-deg sloped hopper with 77-deg cap cone as shown in Fig. 8 proved ultimately to be the optimum design and enabled the handling of $^1/_4 \times 0$-in. coal containing 15 per cent surface moisture.

Use of Stainless-Steel Cones. The use of stainless steel rather than carbon steel for fabrication of the internal cones was investigated. For the cap cone, stainless steel did not appear to be particularly beneficial. However, the use of stainless steel for the inverted cone is recommended. The particular advantage in constructing this cone of stainless steel relates to start of coal flow after protracted retention periods. Coal stored in the test bin for as long as 10 days started to flow immediately upon opening of the outlet, when stainless steel inverted cones were used.

Application to Other Bin Shapes. The idea has been applied to square and rectangular bins. Elimination of the central-core movement by cones, pyramids, and sloped deflector plates has made possible handling of $^1/_4$-in. coal at 10 per cent maximum moisture through a 2-ft by 2-ft square test bin having a 12-in-diam outlet. This same coal has been handled at rates up to 15,000 lb per min through a $48 \times 5^1/_2$-in. outlet at the bottom of a 4×4-ft steel test bin. It is significant that at this extremely high coal-flow rate the shut-off gate could be closed by application of only a 50-lb force on a 48×10-in-wide hinged closure.

Conclusion

If scaled upward to fit the typical bin, the conical interior construction would occupy so much of the storage volume that its use would be impractical.

Rather, the device is an appendage which can be added to the bottom of a conventional-type bin. It provides the means for controlling flow from an opening in the bin, sufficiently large to prevent arching, to an $8^1/_2$ or 12-in-diam outlet which, because of low pressures, can be opened and closed by a relatively simple mechanism.

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The oil and petrochemical industries are successfully metering millions of barrels of liquid hydrocarbons daily with positive-displacement meters, handling everything from asphalt to propane, and at rates from 1/10 to 7000 gpm and greater. The varying physical properties, the ever-increasing flow rates, and the constant striving for greater accuracy have given rise to special problems of meter-proving.

TESTING THE OIL INDUSTRY'S METERS

By **M. L. Barrett, Jr.** Senior Engineer, Research and Development, Shell Oil Company, Products Pipe Lines, Indianapolis, Ind.

METERS must be "calibrated" or proved because they are affected by a combination of environmental conditions: (*a*) Rate of flow through the meter; (*b*) physical properties of the metered liquid, particularly viscosity; (*c*) pressure at which the liquid is metered; (*d*) conditions of repair of the meter, hence the friction; (*e*) extent of air, vapor, or foreign-material entrainment; (*f*) extent of control of evaporation of the test liquid during proving; (*g*) temperature effects on the metered liquid and on the volume of the proving device; (*h*) human errors of reading, calculation, and so on.

It is most important that the meter be proved under conditions which are identical to those under which it is normally expected to measure, and that a sufficient number of check runs be made.

Two basic methods are applicable: (*a*) The gravimetric method which weighs the quantity of liquid actually delivered by a meter and compares this weight with the corresponding meter registration; and (*b*) the volumetric method which gages the volume units actually delivered by a meter and compares them with the corresponding units indicated by the meter register.

There are two procedures for conducting a meterproof run with either of these basic methods. In "the standing start-and-stop procedure" the meter is stopped, read, and a delivery made to a prover, after which the meter is again stopped, read, and the quantity delivered to the prover, weighed, or gaged. The delivered and registered quantities are used to determine the meter accuracy.

In "the running start-and-stop procedure" the proof run is either quite long or the meter is equipped with a special supplementary register which can be read "on the fly," while a predetermined quantity of liquid delivered by the meter is determined without starting or stopping the meter itself. The standing start-and-stop procedure is primarily applicable to short, intermittent deliveries, while the running start-and-stop is advocated for long or continuous deliveries.

Contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference, Tulsa, Okla., September 22–25, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 57—Pet-17, "Positive-Displacement Meter-Proving Methods for Liquid Hydrocarbons."

Gravimetric Provers

The gravimetric method is best applied to permanent installations. It is primarily restricted to use for viscous crude oils, or similar liquids which give gage-glass and wall-clingage troubles in a volumetric method; or to propane, butane, or other high vapor-pressure liquids.

The tank of the weigh-type prover should be isolated from the effects of piping weight, rain, wind, and so on. The system may be equipped with vaporization control by installation of spray facilities for saturating the internal atmosphere in an open tank; or may even employ a tank closed to the atmosphere, where the gas displacement, vapor displacement, or vapor-condensing methods of vaporization control are employed. The gravimetric method requires accurate determination of the gravity of the metered liquid.

The hydrometer is the most popular gravity-determination method, although many operators are using the Westphal balance and pycnometer. For high-vapor-pressure liquids, the pressure hydrometer, pycnometer, and "modified gallon bottle" method are used most frequently. Difficulties are introduced by "apparent" and "true" weights, air-buoyancy effect which involves determination of air density, maintenance of scale accuracy, windage problems on the scale, and the difficulties of determining the accurate specific gravities of high-vapor-pressure liquids such as propane, butane, and so on.

Open Volumetric Provers

The volumetric method of meter proving is in greatest favor in all branches of the petroleum industry. The filling-station meter-and-pump system operating in the range of 3 to 10 gpm is proved into a standard, very accurately calibrated, 5-gal-capacity open test measure; and delivery is identical to that for an automobile. Although this type of prover should be limited to meters delivering 10 gpm or less, the method of use is typical for most open-type volumetric provers.

Portable open-type volumetric provers equipped with pumps for emptying are also in common use. A popular 50-gal size is used in proving truck-delivery meters,

small bulk-plant-type meters, and similar types where delivery does not exceed 50 gpm. Although it does not provide adequate control of test-liquid vaporization for meters used in a closed-line delivery system, portable provers of this general type are built in sizes up to 500 and 1000-gal capacities.

The permanently installed volumetric prover, Fig. 1, may be of either the open or closed type depending upon the liquid involved, and the degree of test-liquid vaporization control desired. Such tanks are usually of the 250 to 2500-gal size, and are usable to prove meters operating at rates which will fill the prover in 1 to 2 min. The prover illustrated holds 1000 gal and is used to prove truck-loading rack meters at around 500 gpm.

Where good vaporization control is desired with motor gasolines and other volatiles, as in the case of pipeline meter proving, it is advisable to equip the top of the tank with a spray of the test liquid, and to saturate the atmosphere drawn into the tank with each emptying.

The provers thus far described are inadequate for rates of flow as great as 10,000 bbl per hr. A single-weir open prover designed by Interstate Oil Pipe Line Company for high-capacity service, Fig. 2, can have as large a volume as desired, and vaporization control can be included. Those that have been built are around 500 bbl. A knife-edge slot or weir near the bottom of the main body of the tank is used as an overflow to establish the bottom zero level of the prover. The top neck has a reduced cross-sectional area equipped with a gage glass and scale. The lower zero or starting level is obtained by draining the tank through the discharge valve until the liquid level is slightly above the zero line, then the remaining liquid is drawn out through the weir-box drain until flow stops.

A variation of the single-weir-type tank is equipped with a second overflow weir at the top. There is a fixed, calibrated volume between the levels of the two weirs, and the amount of liquid which overflows the top weir during a proof is conducted to a supplementary small-diameter reading chamber having gage glasses and calibrated scales.

Closed Provers

The petroleum industry meters a number of liquids where vapor pressures would cause excessive vaporization of the test liquid if they were discharged into an open-type prover. A closed-type prover is mandatory for such liquids as butane, propane, and natural gasolines, one in which the test liquid can be confined under its reference pressure of measurement or slightly higher. Additionally, meters which deliver to completely closed systems such as pipelines require complete vaporization control during their proof to provide maximum accuracy. Some closed provers give better vaporization control than others, and the extent of this will be pointed out in the description of the various types of provers.

There are about seven basic closed-type provers commonly used today. The first four listed can be operated as either gravimetric or volumetric systems: (*a*) Gas displacement; (*b*) vapor displacement; (*c*) water displacement; (*d*) vapor condensing; (*e*) master meter; (*f*) bidirectional piston displacement; and (*g*) unidirectional piston displacement.

Of this group, proving systems (*c*), (*d*), (*f*), and (*g*) can be expected to give perfect control of vaporization of any test liquid. Vaporization control in the master-meter method will depend entirely upon the manner in which the master is proved.

Fluid Displacement Provers

A typical gas-displacement prover utilizes the application of gas pressure to the inside of the prover tank to maintain evaporation control of the test liquid.

The vapor-displacement prover is particularly adapted to the proving of meters in liquefied-petroleum-gas (LPG), anhydrous-ammonia, and other high-vapor-pressure liquid service. The vessel is usually of the conventional shape with top and bottom gage glasses. A vapor-equalizing line communicates the vapor space of the supply tank with the top of the prover, allowing vapor of the test liquid to pass freely between the prover and the supply tank. As liquid is pumped from the prover, it is replaced with vapor from the supply tank; and alternately, when a meter test run is made, the vapor is displaced back to the supply tank. In principle, this proving method maintains an equilibrium condition of liquid and vapor, and loss of test liquid during a proof is prevented.

The dual-tank water-displacement method of closed-meter proving, Fig. 3, is primarily useful for high vapor-pressure liquids such as LPG and employs water or some other immiscible liquid to isolate the test liquid from the atmosphere. In operation, the test liquid is piped to the top of each prover and a water bypass connects the two bottom necks. One vessel is filled with water and the other with test liquid and all air or vapor vented from the system. With the water-test liquid meniscus in the top gage glass of one of the tanks, a proof run is made to that tank pushing the water to the second tank, and in turn pushing the test liquid in the second tank out of the system. Flow is continued until the meniscus appears in the bottom gage glass. Subsequent test runs are made by alternating the test-liquid inlet between the tanks to repeat the water displacement from its tank for each run. This arrangement does not require a prover return pump. In a single-tank procedure, one of these provers would be replaced with a water-receiving sump, and the water pumped back into the prover for each test run. Caution must be exercised in using this method when the test liquid must be kept dry.

Vapor-Condensing Prover

The vapor-condensing prover was devised by Phillips Petroleum Company for liquefied petroleum gas. The prover tank itself has no gage glass and is water-calibrated to gage its fixed volume when completely full of liquid. Test liquid from the meter is brought to the top of the pressure vessel where it is thoroughly sprayed into the tank. The bottom of the prover is provided with suitable pump and hose to evacuate the liquid.

Bottom and top test valves are used to determine when the prover is completely empty and completely full of liquid, since these conditions must exist before and after a proof run. After several preliminary fillings and emptyings, a portion of the vapor in the prover is bled to atmosphere to reduce the pressure to a predetermined

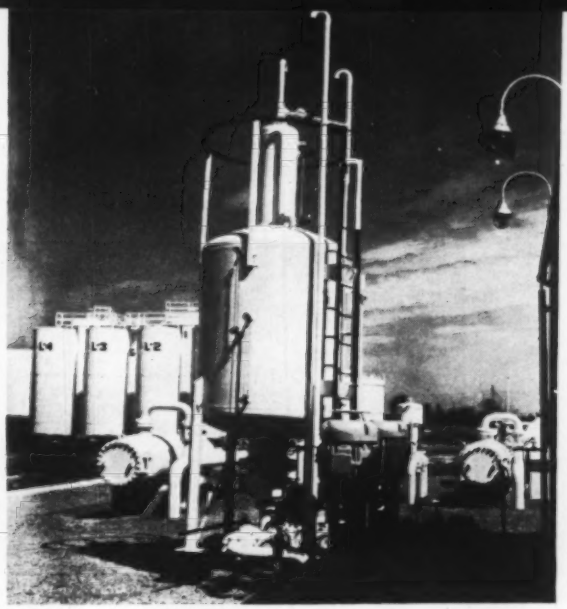

Fig. 1 A 1000-gal open-type meter prover equipped with top spray for vaporization control

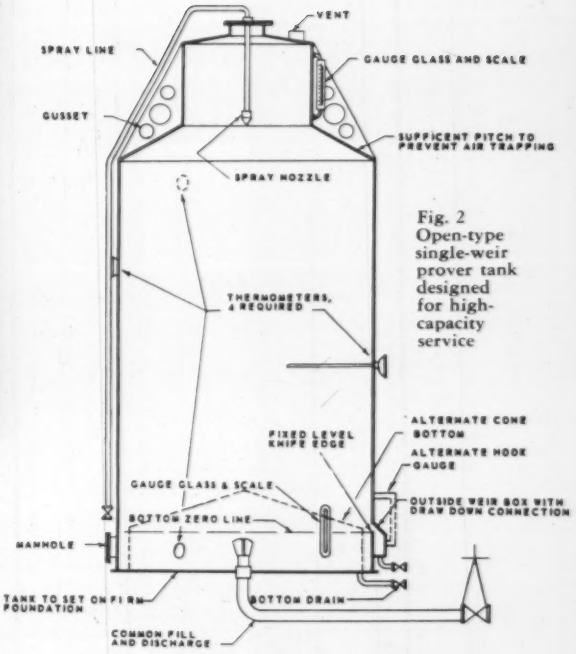

Fig. 2 Open-type single-weir prover tank designed for high-capacity service

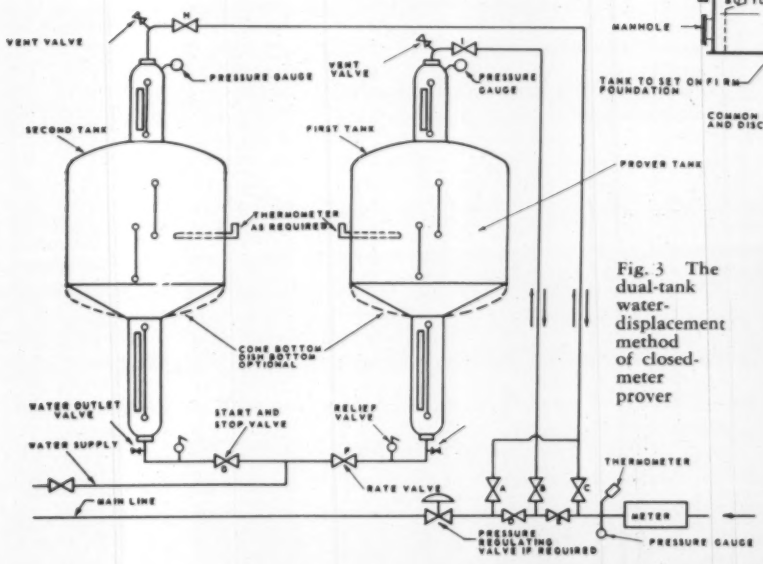

Fig. 3 The dual-tank water-displacement method of closed-meter prover

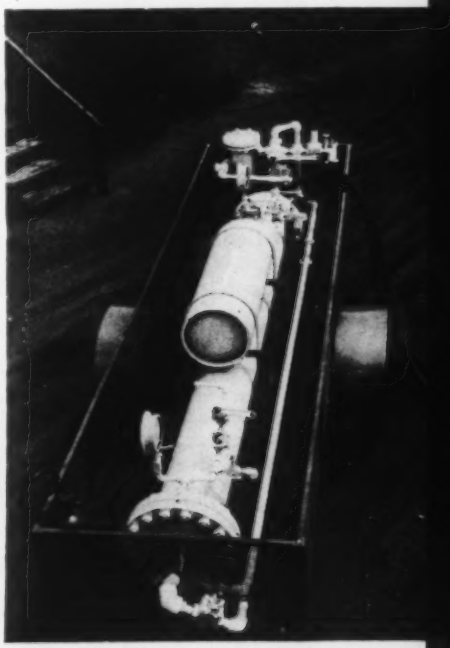

Fig. 5 Bidirectional free-piston displacement prover with the top cover removed

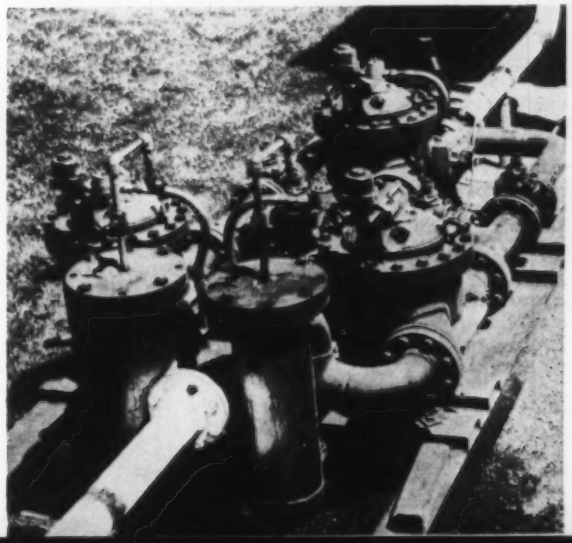

Fig. 4 Skid-mounted portable master-meter unit with electro-mechanical proving registers

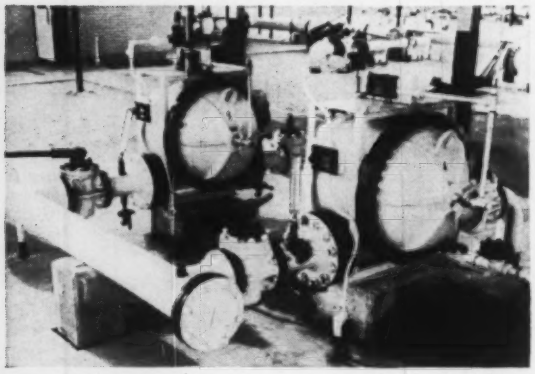

Fig. 6 A 5200-bbl per hr pipeline meter installation with solenoid-actuated registers

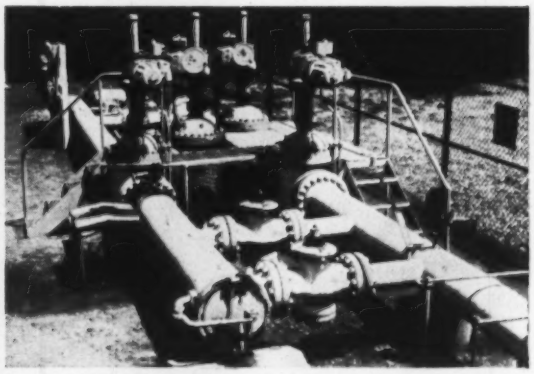

Fig. 7 The scraper launching barrel for a meter-prover section installation at a pipeline terminus

level. This has been established at 10 psig by Phillips, for which pressure they have arranged tables of temperature-versus-liquid content in the vapor space. The amount of liquid actually delivered to the prover is equal to its water-calibrated volume minus the tabulated liquid content of the vapor in the prover at the start of any test run.

Master Meter

In some operations, proof of a meter while in service with a second or "master" meter is considered expedient and sufficiently accurate. Semiportable master-meter proving units, Fig. 4, are capable of deliveries up to 2200 bbl per hr. Such units vary from small meters which can be transported by hand and connected in series with the meter to be proved, to large permanently installed meters which can be connected alternately in series with any one of a battery of meters in a large installation.

Bidirectional Piston Displacement

A meter-proving procedure developed by the Shell Oil Company especially for high vapor-pressure liquids such as LPG is the bidirectional free-piston-displacement prover, Fig. 5. This prototype model is portable and suitable for towing by a vehicle. For instance, it can be quickly connected to a propane delivery truck for a proof of its meter.

It consists basically of a honed-steel cylinder in which a precision-machined piston is caused to reciprocate. The piston is sealed against the cylinder walls by means of a standard O-ring and antifriction rings and is propelled through the cylinder by the metered liquid.

The ends of the cylinder are closed except for a 2-in. pipe extending through the center of each closure to the inside of the cylinder. Externally, these 2-in. pipes communicate to a four-way, four-port, two-position valve. The remaining two ports of the four-way valve communicate by means of flexible hoses to the meter outlet and the fill connection of the vessel containing the liquid of the test draft. The inlet hose from the meter to the prover is equipped with a suitable sight-flow glass and a strainer. The outlet hose from the prover is equipped with a sight-flow glass and a differential valve capable of creating a back pressure sufficient to prevent flashing of the liquid.

The prover is intended to remain full of the test liquid and is provided with excess-flow valves, pressure-relief valves, thermometers, pressure gages, vapor vents, and so on. An expansion chamber, which provides the necessary 15-per cent vapor space only when the unit is in transit, and a protective hood over the top, qualify the prover for transportation over the public highways when full of liquid.

In operation, the inlet hose to the prover is connected to the meter to be proved, and the discharge hose of the prover to the fill connection of the supply vessel. The meter-delivery pump is started, and the piston driven to either extremity of the cylinder where the liquid flow through the meter is automatically and completely stopped. The 4-way valve is manually repositioned to its alternate position, which reverses the direction of flow of liquid through the cylinder and drives the piston to the other extremity of the cylinder. During the first two or three cycles of the piston from one end of the cylinder to the other, the proper back pressure is adjusted at the differential valve, and the vents at each end of the cylinder are blown sufficiently to insure that no vapor remains inside the cylinder.

With the piston at either end of the cylinder, a meter reading is taken and the four-way valve moved to start a displacement of 50 gal of liquid. When the piston stroke is completed there is an automatic stoppage of all liquid flow, insuring a delivery of exactly 50 gal. At this point, the final meter reading is taken and the meter accuracy may be computed. The operator may rapidly make as many proof runs as he desires simply by changing the position of the two-position, four-way valve manually.

The advantageous features of this bidirectional displacement prover may be summed up as follows:

1 It can prove meters on any type of liquid but is peculiarly adapted to meters operating on vapor pressures

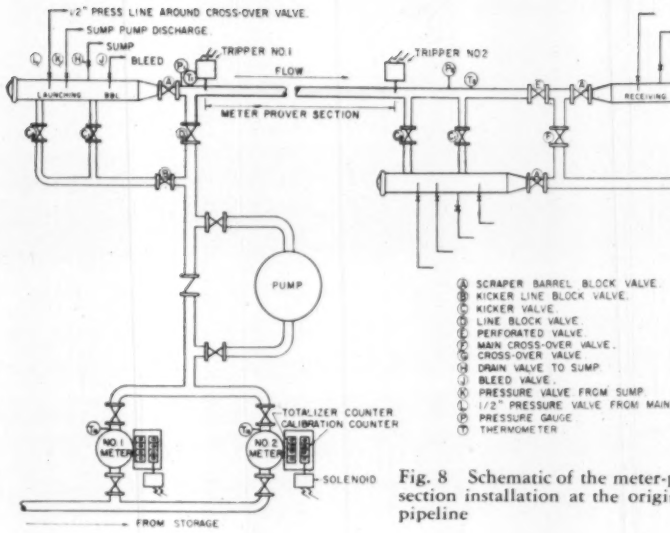

Fig. 8 Schematic of the meter-prover section installation at the origin of a pipeline

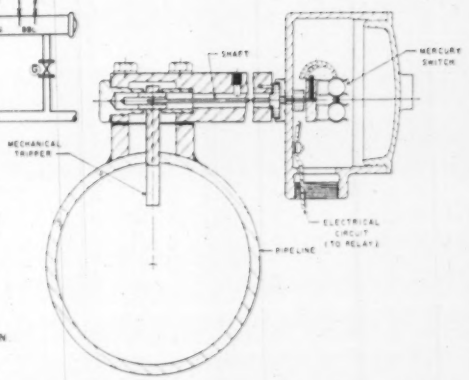

Fig. 9 One type of pipeline scraper indicator tripper which actuates an electrical switch

considerably higher than atmospheric, such as butane, propane, and so on.

2 The test liquid is never permitted to pass from its liquid phase into its vapor phase thereby eliminating any errors which might result from evaporation or vaporization.

3 The mechanical determination of the volume of the test draft is very accurate and eliminates human errors.

4 Temperature effects on the test draft are insignificant because of the rapidity with which meter tests can be made.

5 A meter can be tested at its normal operative flow rate and pressure, and the flow rate will remain constant from the beginning to the end of the test draft.

6 One man can operate the prover easily and rapidly, and there is no need for auxiliary power or a pump to remove the test liquid from the prover.

7 No charts, graphs, vapor tables, or other technical data are required; and the calculations are quite simple.

8 Accuracy and reproducibility of test results are of the highest order.

9 The equipment may be permanent or portable and can be constructed with delivery capacities other than 50 gal.

Refinements in the design of the prototype prover have been accomplished by the Jensen Engineering Co., Tulsa, Okla., marketers of the system.

Unidirectional Piston Displacement

The unidirectional free-piston-displacement proving method, Fig. 6, was inaugurated by the Shell Oil Company in 1952, and there are 12 such installations in its pipeline system for proving pipeline meters. Most of these can be operated and proved at 5200 bbl per hr bph.

A scraper-launching barrel, Fig. 7, is a device by means of which a scraper or piston can be passed through a section of line to displace the precalibrated volume between its extremities. Meter-proving counters on the meters are electrically triggered to register only during the time when the scraper is passing through the meter-prover section. A schematic of meter-prover section installation at the origin of a pipeline is shown in Fig. 8.

The scraper is caught and removed from the pipeline by means of a scraper-receiving barrel. When it is desirable to loop the pipeline meter-prover section, the scraper-receiving barrel is installed near the site of the meters and adjacent to the scraper-launching barrel.

A workable size for the meter-proving section would be about one tenth of the normal flow in barrels per hour through the meter or meters to be proved, but in no case should its capacity be less than 10,000 times the least reading of the meter register if measured quantities are to be determined within 0.01 per cent.

Any excessive bends or other features which might disrupt the uniform passage of a scraper should be eliminated. An internal line-up clamp, equipped with a tight-fitting copper cylindrical shoe, was used at the pipe welds to prevent the formation of welding icicles.

A mechanical tripper with an electrical switch, Fig. 9, can be employed at the extremities of the meter-prover section to determine the instant a scraper passes that point in the line, by actuating the switch through a torque-tube arrangement.

A suitable piston or scraper for meter proving by this method consists simply of a stiff steel shaft with slightly oversized pump cups or disk-type scraper rubbers attached to each end.

Each meter in a group of meters being proved is equipped with a register comprising two counters. The totalizer counter continuously records the accumulative flow through the meter. The proving or calibration counter is automatically engaged by a tripper through solenoid action and automatically disengaged by another tripper when the solenoid is de-energized.

The determination of the displaced volume of a meter-prover section is a precision calibration job that should be undertaken only by competent personnel. Mathematical calculation of the volume of the section is not sufficiently accurate.

A meter-prover section installed on the upstream side of meters and their strainers is calibrated with a skid-mounted portable master-meter unit connected in series with the meter-prover section. Each meter on this unit is equipped with both a totalizing and solenoid-

actuated proving counter. Each meter is very carefully prechecked against a conventional 1000-gal prover tank. With the same stream passing through the master meters and the meter-prover section, a standard scraper is shot through the section, and the registration thereby accumulated on the solenoid counters of the master meters, corrected for meter factor, rate of flow, temperature, and pressure, is the net capacity of the meter-prover section. Because the same type of scraper is used for prover calibration and meter testing, any alleged slippage across the scraper is washed out automatically and will not influence meter accuracies. Additionally, if there is electromechanical drag or lag at the start of a meter-prover section there will be an equal lag at the end of the section, and any effect is insignificant.

In practical, every-day operation, the meters involved are proved by simply launching a scraper from the launching barrel and allowing it to be received in the receiving barrel. The base volume of the meter-prover section is adjusted on the basis of the average of the pressures and temperatures at both trippers, and this adjusted volume is compared to the total registration appearing on the proving counters of the meters.

While the initial cost of a remote scraper station and the necessity for operating personnel to handle and maintain scrapers may be considered disadvantageous, there are advantages which make it highly usable in many meter-proving situations. These are as follows:

1 Meter tests are accomplished without diverting, disturbing, surging, or slowing down the normal stream flow.

2 The test run is completely automatic after dispatch of the scraper, so that a high degree of operating technique is not required to obtain an accurate proof.

3 The system is an entirely closed one providing complete vaporization control, eliminating the venting of hazardous vapors, insuring safety and accuracy in the test operation.

4 The flow rate at which meters can be tested is unlimited.

5 Reproducibility of test results with the method is excellent and can be considered to be within 0.02 to 0.03 per cent.

Conclusion

In the choice of a meter-proving system for positive-displacement meters, the user may choose either the gravimetric or the volumetric-type prover, and within each category he may employ either the open or closed type depending upon the necessity of preventing vaporization of the test liquid. Consideration should be given to the "running" versus "standing" start-and-stop-type proof. Most provers described herein can be built in sizes and shapes other than those presented.

In general, the number of meters involved in an installation, the maximum expected flow rate, the physical properties of the test liquid, the extent to which vaporization must be controlled, the first cost and the operating cost, along with the desired speed and accuracy of proof, are items which must be given thorough consideration in the design of a meter-prover system.

MANAGEMENT . .

By Allan Harvey, Operating Partner,
Dasol Corporation, New York, N. Y.

CURRENT discussions of automation are off in all directions at once. At management and engineering meetings and in the literature, we are told by responsible authorities that automation is new and momentous, or that it is old and really just a figment of the publicist's press release. Management is castigated alternately for being inert in the face of automation's profit potential or for recklessly investing its hard-earned capital in computers that do not earn their keep. A leading management journal blames automation for a disastrous $8-million fiasco, then credits automation with fabulous economies in another company. In the field of distribution engineering, a serious analysis of why "distribution industries do not lend themselves to automation" appeared recently, while an equally knowledgeable author, after surveying a number of installations, reports in a responsible journal that "distribution is fertile ground for automation engineering."

To explore the role of engineering in our rapidly changing technology it is important to know how new automation really is, what is the essence of its newness, and what difference—if any—that makes to the engineer. If it is not fundamentally new; if it is, as many have said, just a further extension of mechanization techniques, then indeed as engineers we could only clutter our thinking by using a new word for an old concept. It is suggested that, in fact, the opposite is the case.

There is something so radically new going on in our industrial technology that it invites a reorientation of some of our engineering concepts and practices, and ultimately of engineering education. We think that it is important that we as engineers analyze what it is that is new because it involves a new relationship between management and the engineering function, and between engineering and other professional functions.

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....and.....ENGINEERING

...in the AGE of AUTOMATION

Automation is not merely mechanization but a new concept rooted in the idea that the ultimate efficiency in a business is achieved when the business is organized, engineered, and operated as an integrated organic system, centrally and automatically controlled. Carried to its logical conclusion, the integration of all the functions of a business—purchasing, production, sales, distribution, and accounting—is the goal.

As a framework for analyzing these convictions, five propositions will be elaborated:

1 Automation is a new concept of business organization that implies significant departures from conventional engineering practice.

2 This concept is new because it conceives of a business enterprise as an organic system, not as a group of departments, divisions, or operations.

3 The validity of automation—and the only justification for regarding it as a new concept that needs a new name—lies in the proof that by thinking of business as an organic system new economies can be achieved, over and above those that can be contemplated, if we continue to think in terms of mechanization, automatic machines, or even "the automatic factory."

4 The engineering implications of this new concept are obscured or negated by confusing "automation" with advanced or automatic mechanization. Mechanization can increase efficiency only by improved engineering of particular operations. The application of automation gains new—and usually much greater economies—by making possible the engineering of a total system, by focusing on the integration of the flow of materials, products, and paper work through the system and balancing that flow by automatic controls. In so doing, more efficient use is made of men and machines and those other two costly items, space and time. To these economies, automation adds the economic use of machines in operations that hitherto have defied mechanization. It replaces much of the human decision-making function by the use of automatic controls. Automation holds its greatest promise, not in production processes, but in the handling of materials and paper work, where mechanization can have least real impact unless and until automation concepts are introduced.

5 This broad and basic way of thinking about the entire business system involves over-all top management decisions, within the framework of which the functions of the engineer and the architect, and their relationship to top management are drastically altered.

What Is New About Automation?

Automation is a new concept rooted in the idea that the ultimate efficiency in a business is achieved when the business is organized, engineered, and operated as an integrated organic system, centrally and automatically controlled. The newness of automation is thus twofold. It recognizes that only system integration makes it possible to take efficient advantage of automatic control techniques. For example, maximum automatic control of warehouse operations—and therefore maximum efficiency—is achieved only when the flow of materials within the warehouse is integrated with production scheduling, paper work, and sales policy. Conversely, it is the new use of available communications and control techniques that makes it feasible to achieve levels of integration never before possible. Carried to its logical conclusion, automation sets as a new goal for business the complete integration of all the functions of the business—purchasing, production, sales, distribution, accounting—into one balanced flow under the control of a single, central automatic control.

This point is perhaps clearer if we consider how we arrived at the present state of our business organization and industrial technology.

The industrial revolution looked at a product, broke it down into operations, and assigned the operations to men or to machines. Fifty years ago the assembly-line concept began to have its impact, and operations were broken into smaller and smaller units.

This process was peculiarly related to the logic of the machine. The more you divide production up into discrete units, the more susceptible it is to mechanization. But alongside this concept of mechanization there grew up a broader concept, the more general principle of the division of labor. Its dogma was that by breaking even nonmechanical functions into pieces, you permitted greater specialization, and that this meant greater efficiency.

This was elaborated as a management engineering con-

cept by Frederick W. Taylor (1).[1] His philosophy of scientific management, announced in an address to the Detroit Meeting of The American Society of Mechanical Engineers in 1895, and developed later during his presidency of the Society, was an exposition of the primacy of piecework. This was appropriate, because the science that his "scientific management" was inviting management to apply was a revolt against the "synthetic science" of Herbert Spencer. It was a science of analysis and specialization, and its great accomplishments were the breaking down of the universe and everything in it, including human mind and behavior, into bits and pieces. The science of Taylor's day was thus an invitation to management to analyze not only production but every other aspect of business, and to seek efficiency of the whole from efficiency of the parts.

The end result of this is that the tasks of the business have been broken down into bits and batches. Some are highly mechanized, especially in production. Others, notably in office work and in distribution, are still largely handwork. In any case, the efficiency of the business consists in doing each disparate operation, whether by man or by machine, as efficiently as possible. This is as far as this type of technology could go, or can ever go. These are the management and engineering concepts which automation challenges with its new concepts of system integration and automatic control, with their promise of new economies. It is helpful to understand that, since Taylor invited management to seek salvation in science, new concepts have taken over in science, such concepts as homeostasis in biology and Gestalt in psychology, and entropy in physics. These concepts recognize for the first time that systems have special properties and that efficient function of the system is greater than that of the sum of the efficiency of its parts. This organicism defines efficient functioning as a property of the system as an organic whole and of the dynamic interrelationships and intercommunication among the component parts. While automation does not demand that businessmen or engineers delve into the philosophical implications of this important change in science, it does suggest that, if management is to evaluate automation, it would do well to understand that automation's scientific underpinnings are rooted in the science of today and are the direct antithesis of those that underlie bits-and-pieces mechanization.

It is, furthermore, of little meaning that in engineering an automated system it may prove useful to use old techniques, such as feedback or automatic machines, or new electronic controls and computers. In its systems engineering, automation will use any available technique, old or new, but it will always use it in a new way, in a way that will contribute to the integration and automatic control of a system.

The Implications for Management

To automate or not to automate is a top-management decision. This follows inevitably from the nature of automation. Only top management has the responsibility to think so broadly about the basic organization of the business, and it alone has the authority to make a decision that may involve fundamental changes cutting across organizational lines.

In the face of the economies of automation where it has been applied, what explains the slowness with which it is being accepted in industry?

The reason that management does not recognize the potential of automation is related to the confusion of automation with mechanization. But even where that is clarified, there is the residual impression that the advantages of automation apply primarily to the production process. There is little awareness that the efficiencies of automation, even in production, lie for the most part in the untouched areas of the handling of materials, products, and paper work.

The potential is enormous. A Society for the Advancement of Management study (2) showed that, in a group of factories studied, there were seven times as many handling operations as production operations. Only in one case was the ratio as low as three to one. A Westinghouse study of its plants included in the same reference showed that the average part was handled 100 times, and that this took 26 per cent of the man-hours in the plants at a total cost of over $10 million a year. Other manufacturers report that 10 to 40 per cent of direct-labor costs are in handling rather than in direct production. In distribution operations, the handling costs are even higher, averaging from 25 to 50 per cent of the total cost of doing business.

The paper-work problem presents similar opportunities. In 1900 there was one clerical worker to every 30 production workers. By 1950, the ratio was one clerk to every $2^1/_2$ production workers. While the number of clerical workers in 1900 was less than 4 per cent of the total working population, by 1950 it was over 12 per cent.

Elsewhere we have reported cases in which warehouse automation reduced direct-labor costs as much as 61.2 per cent. Bright (3) has highlighted the economies of automation other than those resulting from the elimination of direct labor. He cites, for example, a parts firm that cut lead time from 19 days to 2 to 3 days; a feed mill that cut lead time from 2 hr to 5 min; and an engine plant that increased equipment utilization by one third. Several cases can be cited in which, as a result of these multiple economies, warehouse automation has paid for itself in a little over one year.

These facts and figures, however, have not converted many managements to automation. Apparently this reluctance is rooted, in part at least, in the notion that what they think is automation is peculiarly applicable to certain companies. As far as automated materials handling or paper work is concerned, there is no type of business whose operation is not susceptible to a substantial degree of integration and automatic control. Common *misconceptions* are:

Automation is applicable only to large firms. Diebold (4), in his work in the field of production automation, has pointed out that automation is peculiarly adaptable to the small job shop. Highly automated materials-handling and distribution systems for large, medium, and small firms have been designed, engineered, and installed with substantial economies in each case.

Automation cannot be piecemeal. On the contrary, once

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

management has accepted the concepts involved, the implementation—and much of the investment involved—can be piecemeal. It is true that the system must be studied or engineered as a whole. Increasingly, we find it advantageous to study an operation, engineer an appropriate system, and then design and install the paper-work flow and production control, leaving for later the installation of the materials-handling system, which involves the largest part of the capital cost.

The investment is prohibitive. There is abundant authority for stating that an automated installation need not cost more than a conventional mechanized system. The increased efficiency of automation may require less equipment and less space than a comparable nonautomated system with a high degree of mechanization.

Maintenance costs are high. Bright (3) has reported on automated production installations that do not have a maintenance engineer and whose downtime is considerably less than was the case before automation. An automated warehouse, installed 3 years ago, has required only routine quarterly service checks up to the present time.

An automated system is inflexible. Diebold (4) has stressed the fact that, in production, automation greatly increases flexibility because automatic controls can make machines more versatile. Indeed, it is this flexibility that increases the economies of automation in the small operation and permits changes in the operation and allows for growth.

Each automation installation is different, and therefore unproved. That may have been true a year ago, but it is not true today. Most of the elements of such systems are now tried and proved.

The really valid obstacle to management's more rapid acceptance of automation is the shortage of experienced automation teams. This is the essence of the challenge to engineering.

What is the nature of such an automation team? The minimum essential automation team includes mechanical, industrial, and electrical engineers, all of whom have some familiarity with operations research and the implementation of this research by systems engineering. Since any systems automation involves materials handling—especially so in distribution automation—the team must have specific experience in materials-handling engineering. They have to know what mechanical techniques and equipment are available for the physical handling of materials, and what electromechanical and electronic circuitry and equipment are available for controlling the flow. Because in the optimal system the flow of information is integrated with the physical flow, the team has to embrace experts in data processing and programming so that the application of these to each assignment can be evaluated. Having put together a team with these rare qualifications, there remains the even rarer skill that can come from practical experience alone.

How does management get access to such a team? Every member of this team is a new kind of engineer with a theoretical grounding that cuts across established engineering specialties. In this day of a general shortage of conventional engineers with high-level conventional experience, it is not hard to understand why it is difficult to recruit engineers with the required special background and experience.

Assuming the organization of such a group within a company, it would take a large and diversified company and a long period of time for this group to acquire the wide practical experience needed in automation-systems engineering. Again, if the initial investment in building and training such a company team were practical, there are few firms that would have a continuing flow of automation-engineering projects sufficient to keep such a team busy enough to make the investment in the team profitable.

This would seem to favor those who argue that the future of automation depends on the development of independent teams of automation engineers who, because they practice nothing but automation-systems engineering, can keep abreast of the new developments in the field. Because their day-to-day experience involves a variety of problems, such a team will be able to develop and test a variety of solutions to these problems, and thus will be uniquely equipped to apply this new know-how to any given engineering problem.

In any case, just as top management has to make the decision to take a good look at automation, so management has to decide whether it is more practical to develop the know-how within its organization or to go outside. But inside or outside, it is this type of versatile and experienced team that alone can sit at management's side when systems automation is evaluated.

Some Conclusions on Automation

The decision to automate or not to automate means a broad exploration into the company's operation. Once that step is taken, the implementation can be piecemeal without materially affecting the company's ability to take advantage of the economies of automation.

The current relentless squeeze on profits can be mitigated by raising prices, which will be increasingly difficult in the buyer's market of the foreseeable future, or by a renewed assault on costs which, of course, is the essence of automation's promise.

The costs of handling and the paper work attendant upon increased volumes of business represent the greatest increments of cost. Wages in these fields have increased proportionately more than those for production labor. There is every reason to believe that this upward pressure will continue. It is of real significance that it is precisely in these areas that automation offers the greatest promise of economy and the greatest challenge to management leadership.

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Safe design goes beyond mechanical stresses and forces: It takes into account exposure of personnel to accident

Designing for SAFETY

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Modern Materials Handling, Boston, Mass.

PROTECTION is an integral part of a well-designed machine. True safe design insures that the operator or the casual visitor will not be hurt by being caught in shear, pinch points, reciprocating parts, or by flying missiles. This means removing or modifying hazards through controls built into the over-all design.

A hazard is any movement of materials, equipment, or persons—or potential movement, as illustrated by the possibility of collapse of floor or roof, or of boiler explosion—that exposes persons to possible injury.

An occupational-disease hazard is one that could produce changes in bodily function, condition, or appearance. Examples: Silicosis, asbestosis, lead poisoning, dermatitis. These changes in bodily function may be due to inhalation, ingestion, absorption, or contact.

There are principles which serve as a starting point, not only for safety engineers, but for designers, product engineers, and manufacturers who wish their machines or products to meet their safety obligations to the customer and the public.

Principle of Preventing Contact

The first principle requires that the casing, enclosure, guard, or other safety device shall function in such a manner that physical contact between the moving parts of the machine or apparatus and the person becomes impossible.

Where permanent machine construction to fulfill this requirement is impossible, the following types of guards can be used to carry out this principle: Fixed guards, automatic or semiautomatic feed devices, automatic sweep or pull-out guards, two-hand trip devices, trip guards, and interlocks.

Fixed-Barrier Guards. A fixed, or positioned-type guard is perhaps the most elementary type. Yet, where it can be used without hampering the operation or obstructing vision, it should be first choice because of its reliability and its simplicity of construction, operation, and maintenance. It should be built into the machine.

Fixed-barrier guards may be subdivided into two general classes—those that require an opening to receive stock, and those that do not.

To be effective, the first type requires that the opening for stock be designed properly in relation to the distance from the hazardous point of operation. The following empirical formulas were derived from data taken from various test fixtures and a wide range of hand sizes to determine the amount of travel through various size openings.

1 Maximum safe opening between two horizontal parallel bars

$$X = 1/4 + 1/9Y$$

2 Maximum safe opening under guard over feed table (palm of hand resting on flat surface)

$$X = 1/4 + 1/8Y$$

where X = maximum safe opening or height, in.
Y = distance tip of third finger extended beyond opening of guard, in.

Figs. 1 and 2 show typical applications of this principle. Fig. 3 shows how the equations would be applied to the case of inrunning rolls.

The fixed-barrier guard in which there is no opening for processing stock is generally used to safeguard drive mechanisms and moving parts. For this type to be effective it must be designed so that there is a relationship between the distance from the danger zone and the material used for guard construction. For example, if the material is expanded metal and has openings large enough to permit a finger to pass through, then the dangerous moving part should be such a distance from the guard that contact with a person's finger is impossible. Table 1, showing "Standard Material and Dimensions," applies this principle and is taken from ASA code B15.1–1953.

Automatic Devices

Feed and Ejection. Automatic or semiautomatic fee

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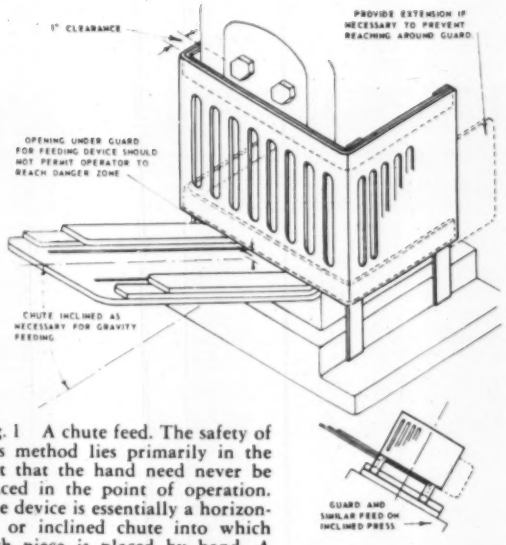

1" CLEARANCE
PROVIDE EXTENSION IF NECESSARY TO PREVENT REACHING AROUND GUARD
OPENING UNDER GUARD FOR FEEDING DEVICE SHOULD NOT PERMIT OPERATOR TO REACH DANGER ZONE
CHUTE INCLINED AS NECESSARY FOR GRAVITY FEEDING
GUARD AND SIMILAR FEED ON INCLINED PRESS

Fig. 1 A chute feed. The safety of this method lies primarily in the fact that the hand need never be placed in the point of operation. The device is essentially a horizontal or inclined chute into which each piece is placed by hand. A pick should be provided, to remove stock that may jam in the die.

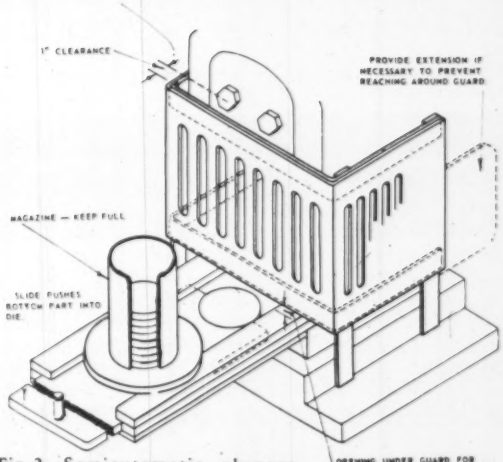

1" CLEARANCE
PROVIDE EXTENSION IF NECESSARY TO PREVENT REACHING AROUND GUARD
MAGAZINE — KEEP FULL
SLIDE PUSHES BOTTOM PART INTO DIE
OPENING UNDER GUARD FOR FEEDING DEVICE SHOULD NOT PERMIT OPERATOR TO REACH DANGER ZONE

Fig. 2 Semiautomatic plunger feed. The elementary fixed guard, always a first choice because of its simplicity, is indicated here, and the formula for "maximum safe opening under guard" applies. This is a magazine, in which blanks are placed; the plunger then pushes them under the ram.

and ejection devices, Figs. 1 and 2, obviate the need for the operator's putting his hands in the hazard zone, and thus they act as partial safety devices. However, they should be used in conjunction with other safeguards.

Position, Sweep, or Pull-Out Guards. Automatic position guards function before the dangerous operation begins, placing themselves so as to prevent access to the danger area. Sweep, or pull-out guards move so that the operator's arms are pushed, pulled, or swept out of the way before the machine stroke or operation can do injury.

Table 1 Dimensions and Clearances of Standard Materials Used for Barrier Guards

Material	Clearance from moving part at all points, in.	Largest mesh of opening allowable, in.	Minimum gage (U. S. standard or thickness)
Woven wire.....	Under 2	3/8	No. 16
	2 to 4	1/2	No. 16
	Under 4	1/2	No. 16
	4 to 15	2	No. 12
Expanded metal....	Under 4	1/2	No. 18
	4 to 15	2	No. 13
Perforated metal....	Under 4	1/2	No. 20
	4 to 15	2	No. 14
Sheet metal.....	Under 4	...	No. 22
	4 to 15	...	No. 22
Wood or metal, strip crossed.....	Under 4	3/8	Metal No. 16 Wood 3/4 in.
	4 to 15	2	Metal No. 16 Wood 3/4 in.
Wood or metal, strip not crossed.....	Under 4	1/2 in. width	Metal No. 16 Wood 3/4 in.
	4 to 15	1 in. width	Metal No. 16 Wood 3/4 in.
Standard rail.....	Min. 15	Use 1 1/4-in. pipe or 1 1/2 × 1 1/2 × 3/16 angle iron or material of equiv. strength	

Guards are to have a minimum height of 7 ft 0 in. from the floor of the platform level, except for standard rail which must be 42 in. high with a mid-rail between the top rail and the floor.

Two-Hand Trip. Two-hand trip devices require the operator to use both hands to actuate the machine, insuring that his hands will be out of the danger zone. This may be done mechanically, through interlocks; or it may be arranged electrically, requiring the operator to press two buttons to complete a circuit. Fig. 4 shows several types of two-way mechanical interlocks.

Trip Guards. Trip guards (or limit devices) stop the machine when a hand, finger, or other member approaches too close to the hazard zone. Automatic trip guards may take the form of limit switches to prevent damage to equipment such as elevators, when normal controls fail.

The Emergency Button

Manual trip guards are generally used in machines which require a feed opening large enough to admit large masses of material (as in rubber mills) and therefore cannot be guarded with a barrier whose opening is small enough to keep the hands out.

The requisites of a good trip guard are:

1 It must be a quick-acting power-disconnecting device.

2 It must apply a braking mechanism to stop the travel or hazardous movement of a roll, tool, and so on, within approved distances.

The time factor, from the minute the trip guard is actuated until the brake mechanism is applied, is extremely important. Therefore any unnecessary movement should be eliminated. The trips should preferably be finger type and a slight touch should be sufficient to operate them. If the operating circuit is by means of mechanical linkages, they should be kept at a minimum to reduce the effects of inertia; if the operating circuit is electrical, relays should be kept at a minimum since the time factor is increased proportionately with each additional relay. If a trip guard is even slightly actuated, the response at the braking end should be immediate.

When a trip guard opens a circuit, the circuit should remain open until a reset button is manually pressed to close the circuit again.

Braking Methods

A machine must be braked to stop within approved distances. The following methods may be used to accomplish this:

1 A friction brake with a lever and weight arrangement, with force applied automatically when the tripping device is actuated. (The force of a spring against a friction brake is not recommended since springs are weakened with time.)

2 Dynamic braking whereby a running motor of the synchronous or d-c type is disconnected from its supply lines and a resistance load (often the starting resistance) is placed across the armature terminals, thus sending a current through the resistance and causing the motor to act as a generator. This type of device has the disadvantage of being ineffective at low speeds. It should therefore be used in addition to friction brakes.

3 With an induction motor, the emergency trip may reverse the leads. The disadvantage to this type of brake is that it becomes inoperative in the event of power failure and should be used in conjunction with friction brakes.

4 A newer device has appeared in the form of an electromagnetic coupling. This consists of a stationary housing, the outside surrounded by an electromagnetic coil while the inside is filled with oil and iron filings with the disks on the disconnected ends of two shafts rotating freely in the mixture. When a current is passed through the outside coils the iron filings and oil mixture becomes solidified immediately and the two shafts behave as one. Thus one may be a driven shaft and the other the drive shaft. Reversing this arrangement, a very sensitive and effective brake is produced.

Interlocks. Interlocks, Fig. 4, again insure that the machine and its appurtenances are in safe relationship, or in proper place, before the machine can be started, or before a hazardous operation or stroke can begin; or that the opening action of a guard stops the machine or the dangerous moving parts. In either case it should be impossible to restart the machine until the guard is firmly in its normal operating position.

In the case where the machine is already in motion during the removal of a guard, a braking circuit and mechanism, as described under Trip Guards, should be used for quick stops.

Principle of Preventing Injury or Damage

Another principle states that, in the event of accident or the presence of harmful substances, the safety device shall operate to prevent or minimize injury or damage.

This principle differs from "preventing contact" in that it assumes an accident has already occurred, but injury can be prevented or minimized by proper safeguards. For example: An accident occurs when a rivet falls, but the injury is prevented because it strikes a worker wearing a safety-hard hat.

The following types of guards fall under this classification: (*a*) Quick-stopping devices; (*b*) enclosure guards; (*c*) protective clothing; (*d*) local exhausts.

Quick-Stopping Devices. These devices may prevent or reduce the degree of injury or damage once the accident has occurred.

Enclosure. An enclosure of substantial construction should withstand the forces encountered in the event of failure of a machine or part. Examples are: Retaining hoods placed about a grinding wheel in the event the wheel should burst; a tunnel of substantial construction through the runs of a transmission belt to prevent injury in the event of a broken belt; a shuttle target to stop flying shuttles.

The purpose of enclosure guards is to withstand and absorb kinetic energy and only secondarily to prevent physical contact.

The kinetic energy, to be absorbed when a revolving wheel breaks, is as follows:

$$KE = {}^1/_2MK^2w^2$$

where

M = mass
K = radius of gyration
w = angular velocity

The design of the guard should be such as to absorb this kinetic energy within the proportional limit of the material of construction. From Hooke's law the following formula is derived:

$$W = {}^1/_2AS\left(\frac{SL}{E}\right) = \frac{S^2AL}{2E}$$

where

W = energy absorbed
S = stress or force per unit area (in this case the proportional limit)
E = modulus of elasticity
A = cross-sectional area
L = length

This formula defines the resilience or stress energy which may be recovered from a deformed body upon the release of force. Since AL represents the volume of the material, S the proportional limit (in this case), and for any given material S and E will remain constant, then the amount of energy to be absorbed depends on the volume of the material. Therefore for a given material

$V = MK^2w^2$ or for plain disk wheels
$V = Mv^2$

where V is the volume of material to be used in constructing the guard and v is the peripheral speed of the wheel. Since the density remains constant, the weight of the guard may be used as a criterion of strength in choosing or designing a guard with any given material.

Local Exhaust. Local exhausts do not prevent the generation and/or discharge of harmful particles, vapors, or gases into the atmosphere but they minimize its dispersal, thus minimizing or preventing injury. Examples are exhaust hoods on electroplating tanks, degreasing, spray booths, grinding, and abrasive blasting. Machines requiring the use of exhaust should be designed and built to accommodate appropriate duct connections.

Fail-Safe Principle

This principle states that the design for safety shall function so that it always does the right thing to keep the apparatus safe—that, or nothing at all.

Examples of this type of device are: Automatic hi-lo pressure cut-off for oil burners; spring-loaded safety valves; dead-man's controls on diesel trains; motor overloads or low voltage releases.

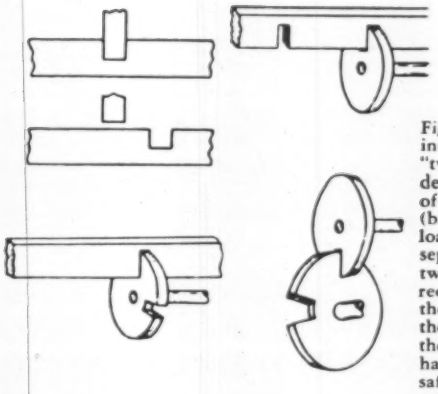


Fig. 4 Mechanical interlocks. For a "two-hand trip" device, operation of the cam and bar (both spring-loaded) can be separated so that two hands are required to line up the slots and move the lever. Thus, the operator's both hands must be safe at the critical moment.

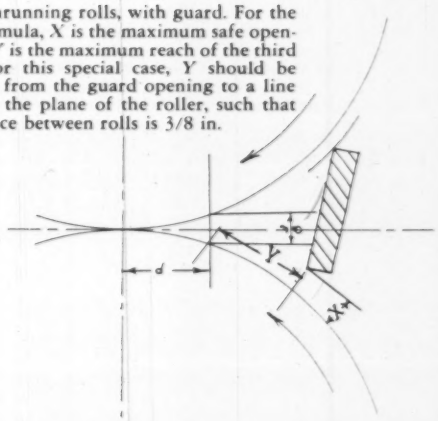


Fig. 3 Inrunning rolls, with guard. For the safety formula, X is the maximum safe opening, and Y is the maximum reach of the third finger. For this special case, Y should be measured from the guard opening to a line drawn in the plane of the roller, such that the distance between rolls is 3/8 in.

Feedback for Safety Principle

This major safety principle demands a continuous monitoring agent which will inform the machine of impending danger or malfunctioning and shall cause it to automatically take action to avert an accident.

Photoelectric Cell. A photoelectric cell composed of a light-sensitive material may be used in conjunction with a light beam to monitor dangerous areas. Disadvantages of this arrangement, however, are as follows:

(*a*) The monitoring beam is not readily adjustable and unnecessary operation of the device may result.

(*b*) The device may be sensitive to background illumination or other sources of illumination.

(*c*) It is difficult to design on the principle of failing to safety.

(*d*) Electronic amplifying circuits are required, and the device may be subject to excessive maintenance.

Other Devices. There are other means of monitoring. Rotating weights, similar to those used in ball governors, can serve as safety devices. A capacity bridge may be used as a monitoring medium: When anything approaches the danger area, the bridge circuit becomes unbalanced, triggering relays to stop the machine. Radioactive material, in harmless amounts, has been used in wrist cuffs, so that when the operator's hands approach danger, a sensitive device, like a Geiger counter, triggers the safety mechanism. Radar may be used by designing a weak high frequency transmitter so that any object within the zone of detection will cause a reflection of radio waves to activate a receiving unit.

Principle of Control

The "Principle of Control" requires that the machine be so designed or so equipped that it can operate only in accordance with the wishes of the operator.

Inadvertent Starting. If the starting torque of a motor is insufficient to start the load, the motor will remain in the stalled position when the starting circuit is closed but may later start suddenly due to nearby vibration. This is an extremely hazardous condition and it is important that the proper motor be selected to meet the starting and running conditions of the machine.

Inadvertent starting can also result when the voltage in the plant fails or falls to a level which is below that required by the motor. In this case the motor stalls, and when the electric power is restored the motor may start unexpectedly. To prevent this, every motor shall have in its starting circuit a low-voltage or no-volt release. Thus if the power fails the circuit is automatically opened and the machine cannot be restarted until a reset button is pressed.

Another factor in inadvertent starting may be the pushbutton itself. Therefore a start button should generally be recessed so that it cannot readily be depressed unless the action is deliberate.

On the other hand, stop buttons should be prominent so that it is an easy task to hit them in the event of an emergency. Push buttons should also be so designed that, whenever a large machine (such as newspaper press) is stopped at any station, the machine cannot be restarted at any other station.

Inching. An inching control enables the machine to be run a very short while, and then stops it after each depression of the button. This type of device is necessary in many operations which require a hazardous machine to be set up and adjusted before it begins its normal run. Examples of its application are large rotary printing presses and wire-rope machines.

Control Circuits. The following factors should be borne in mind:

1 Control circuits should not in general carry full-line voltage.

2 Fuses or thermal cutouts should be located so as to be able to isolate a control circuit from line voltage in the event of malfunctioning.

3 Fuses or overloads should preferably break circuits than complete circuits.

Limit Switches. Limit switches control the travel of a machine or apparatus, such as an elevator car, in the event of an emergency. They find many applications where hoisting or reciprocating motion must be limited or controlled.

References

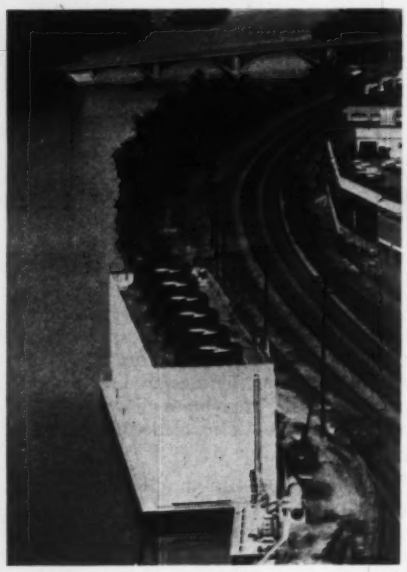
Figs. 1 and 2 have been reproduced from the American Standard Safety Code for "Power Presses and Foot and Hand Presses," Bulletin 1, 1948, pp. 18 and 20.

Fig. 3 is adapted from "Safe Openings for Some Point of Operation Guards," National Association of Mutual Casualty Companies.

Fig. 4 has been reproduced from a paper on "Electrical Control of Dangerous Machinery and Processes," by W. F. Cooper, which appeared in the *American Institute of Electrical Engineers Proceedings*, vol. 98, part II, June, 1951, pp. 349–357.

COOLING TOWERS

The increased use of cooling towers, like this summer stand-by cooling tower, in plants having natural water supplies is an interesting new application. Where a station must be expanded and river flow is inadequate, the cooling tower may be the economical solution, instead of a new plant location.



Hyperbolic natural-draft cooling tower, as used in England. This one has a capacity of 60,000 gpm. Cooler climate, greater fuel costs, and absence of taxes (British plants are government-owned), favor the use of the natural-draft installation in England. This design is not seen in the United States.

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With the doubling of installed capacity by the power industry in the past 10 years, and the parallel growth of all American industry, the abundant supply of once through circulating water has all but disappeared. Today, the cooling tower has become an integral piece of steam-electric station equipment of importance to almost every utility system in the United States. It is often the key to the intelligent economic choice of new plant location as well as the solution to problems of existing plant expansion.

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Contributed by the Power Division and presented at the Power Conference, Allentown, Pa., Oct. 21–23, 1957, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 57—PWR-5.

The First Towers

The type of industrial cooling tower first widely employed was the natural-draft tower, which relied on natural circulation of the cooling medium, air. Although no power expenditure for moving the air was required, performance was unreliable as it was entirely dependent on wind and atmospheric conditions. The towers were comparatively tall structures, with resulting high circulating-water pumping costs. Spray losses were high, thus requiring excessive make-up, and often proved a nuisance with considerable maintenance cost on surrounding equipment.

Mechanical-draft towers of the forced-draft

For steam-electric generating stations, the modern, induced-draft cooling tower grows in importance as cooling demands exceed available water. Even where there is choice, cost figures may favor the cooling tower.

type were next introduced. By forcing the air through the tower at a known rate, a more predictable performance could be obtained. Fan and drive equipment at ground level were convenient for inspection and maintenance. Power consumed in pumping head was greatly reduced. Serious disadvantages, however, were still encountered. The distribution of air over the effective ground area of the tower cell left much to be desired. The fans tended to induce the discharged vapors from the top of the tower back into the tower, resulting in a prohibitive recirculation effect. This design of tower did not lend itself to effective use of the larger diameter fans which were being developed.

Induced Draft Towers

The induced-draft tower is used almost exclusively in the United States today. This design mounts a large-diameter fan of high capacity atop the cell, with a properly designed fan stack, entrance throat, and plenum chamber. The arrangement insures even distribution of air flow throughout the effective cooling volume of the cell. Drift eliminators of the impact type are employed to minimize water loss by entrained droplets in the discharge air stream.

The incoming air is introduced through louvered sides of the cell below the packed cooling volume in the counterflow type of tower and opposite the fill in the crossflow design.

The unavoidable disadvantages of the induced-draft tower, namely, the higher power consumption required to pump the hot air rather than the cold air and the fact that the mechanical equipment is less accessible, are more than offset by its lower initial cost and better air circulation, and distribution characteristics.

Heat is a Substance

In the majority of highly industrialized states, heat itself is considered as a "substance" and, as such, falls under the regulation of the pollution-control boards. There have been instances where various species of fish have been killed because of the temperature rise of the river attributed to the operation of one particular plant. Sufficient pressure can be brought to bear on a plant to require a cooling-tower installation for operation during the critical summer months.

In the majority of cases, however, the cooling tower is employed when an existing generating station is expanded, and the water flow in the river is not sufficient to provide the necessary condenser circulating water during the summer months.

Aspects to be considered in balancing the feasibility of expanding an existing station located on a river by providing a cooling tower for summer service, versus building a new station on another river location, have been discussed in a paper by Mr. Gausmann of the Indianapolis Power and Light Company (1).[2]

[2] Numbers in parentheses refer to the Bibliography at the end of the paper.

For the economics of that particular utility, as reported in the paper, the break-even point depended on the following factors:

1 Increasing the transmission line length by 14 miles.
2 Or increasing the coal cost by 33 cents per ton.
3 Or increasing the plant costs by $6.95 per kw.

Adding Capacity

If, in addition, the consideration includes the question of adding to an existing station as opposed to building a new station, the use of a cooling tower becomes even more attractive. First-cost savings that can be realized in extending an existing plant consist of:

1 Use of existing maintenance facilities.
2 Partial use of existing fuel-handling facilities.
3 Use of existing land for plant and transmission right of way.
4 Partial use of transmission facilities.

Annual costs can be reduced by:

5 Limiting additional supervisory and maintenance personnel.
6 Elimination of any increase in transmission losses.

In most cases of summer stand-by cooling-tower use, the open circulating-water cycle is maintained, Fig. 1, and the cooled water is returned to the river. But this may not be possible. In some localities river flow may all but disappear for a few months a year, and the stand-by tower must of necessity be on a closed circulating-water circuit with the condenser.

Circulating-water velocities with river water are usually limited to 6 to 7 fps because of condenser-tube erosion problems. Operating on a closed system this velocity can be increased safely to 8 fps with an appreciable improvement in station heat rate. A typical set of figures presenting the several factors involved is given in Table 1.

The Lansing Study

The City of Lansing, Mich., made some interesting studies recently to determine its future course in greatly expanding the Moores Park Station (3). The major factors considered are listed in Table 2.

In the first part of Table 2 the possibility of recirculating the water upstream and using pond cooling is considered. Since this would require evaluation on the basis of final station capacity, the estimate is based on four times the water flow required by the immediate expansion planned. To implement this scheme, a 72-in. line 6 miles long would have been required. In the second part of Table 2 the advantage of installing the cooling tower rather than building a new station is shown. In this particular instance, the lack of water flow in the summertime made one of the alternatives mandatory. The cooling tower, using an open cycle, was chosen as the best economic solution.

COOLING TOWERS

Recirculation

Recirculation in cooling-tower terminology refers to the mixing of the warm vapors discharged from the tower with the colder surrounding air, resulting in an inlet wet-bulb temperature[3] higher than ambient. Consideration of this effect must be made by the manufacturer in sizing the tower to insure its satisfactory performance in relation to ambient wet-bulb temperature. The user, in locating the tower, should take certain precautions which will minimize recirculation and insure optimum performance. It is generally agreed that for towers up to 250 ft in length, orientation of the long axis of the tower parallel to the prevailing wind is preferred. Towers longer than 250 ft should be arranged broadside to the prevailing wind.

High structures close to the tower will divert the air discharged from the tower back into the air inlets and extraneous sources of heat will impair its performance. Therefore the tower should be as isolated as economics permit. When nearby heat sources cannot be avoided, the design wet-bulb temperature specified should reflect the estimated increase over ambient wet bulb.

Cooling Tower Institute

Since the founding of the Cooling Tower Institute in 1950, a considerable amount of time and effort has been spent to produce information useful to the cooling-tower purchaser as well as to the manufacturer. Among the data published are:

1 An acceptance test procedure for cooling towers (7).

2 Specifications for redwood lumber for application in cooling towers (8).

3 A report by a technical subcommittee on wood maintenance in cooling towers.

In addition to the bulletins published, a number of research projects are being conducted by the CTI. Among them is a large-scale field study to determine the factors contributing to recirculation. A long-range project, started in 1951, is also in progress to evaluate the effectiveness of wood treatment and the resistance to deterioration of various species of wood.

Hyperbolic Towers

The hyperbolic tower is a unique form of natural-draft design, making use of the stack effect of a hyperbolic chimney-type structure. The air inlet, water-distribution system, and fill are essentially the same as in a mechanical-draft tower. The packed height and hence the pumping head are usually somewhat higher. These towers have been built as high as 310 ft, with a base diameter of 210 ft and a throat of 120 ft, widening to a diameter of 134 ft at the top.

Such towers have never appeared in the U. S., but they

[3] "Wet-bulb" temperature is the temperature of the air entering the tower.

Table 1 Example of Improved Station Heat Rate Through Increased Water Velocity in Condenser

Assumed size of condenser—80,000 sq ft, two pass, 7/8-in.—18 B.W.G. tubes 28 ft long; inlet water temperature 90 F; 85 per cent tube cleanliness.

Assumed size of turbine—150 MW; 2—26-in. exhausts; steam conditions—2000 psig 1050/1000F.

		River	Cooling tower
Water velocity	fps	6.5	8.0
Water flow	gpm	60,000	73,600
Increased pump power due to increased dynamic head and flow	Kw	0	31
Back pressure at design operation	"Hg	3.28	2.88
Change in gross turbine heat rate (2)	Btu/kwhr	0	(−)73
Change in station heat rate	Btu/kwhr	0	(−)92
Fuel savings on basis of 3 months' operation @ 70 per cent load factor, 15 per cent capitalization rate, 30¢/million Btu fuel cost	$	0	42,300

Table 2 Typical Consideration of Alternatives in Evaluating Cooling-Tower Installation on River Location

	Building new plant at new site	Cooling-tower installation at existing plant	Recirculation of river water to obtain "pond cooling" in river
Four unit (176,000 kw total) expansion			
Installation cost	...	$1,120,000	$2,906,000
Annual operating cost (2200 hr per yr)	...	130,000	211,000
Total annual cost (capitalized @ 15 per cent)	...	298,000	647,000
One unit (44,000 kw) expansion			
Installation cost			
Plant & equipment	$10,000,000	$9,117,000	...
Cooling tower	0	302,000	...
Transmission line	1,300,000	0	...
Total	$11,300,000	$9,419,000	
Annual operating cost			
Cooling tower	0	$ 35,000	...
Transmission loss	89,000	0	...
Additional labor	400,000	0	...
Total	$ 489,000	$ 35,000	
Total annual cost (capitalized @ 15 per cent)	$ 2,184,000	$1,446,000	...

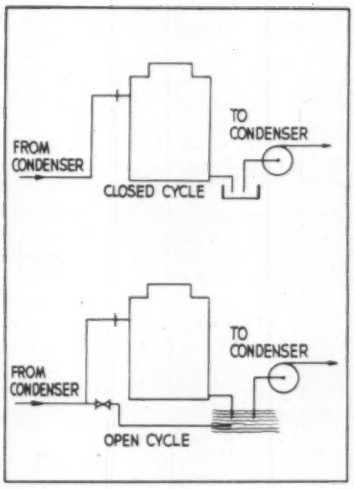
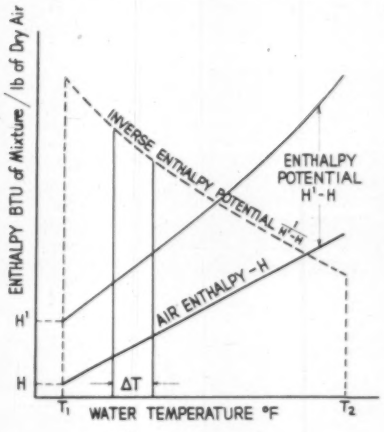
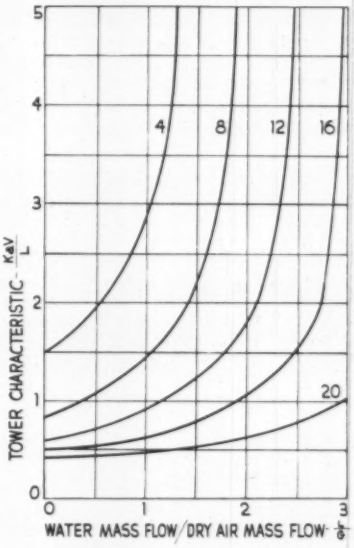
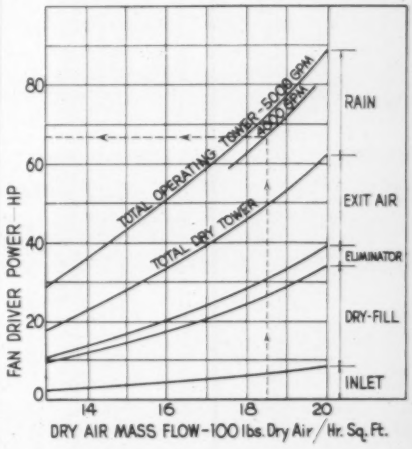
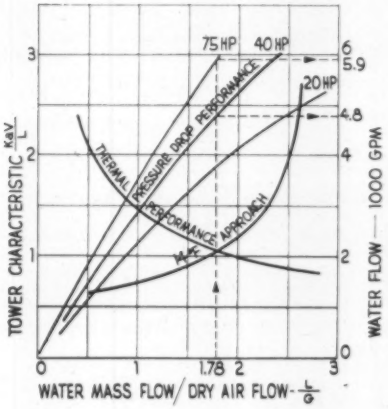


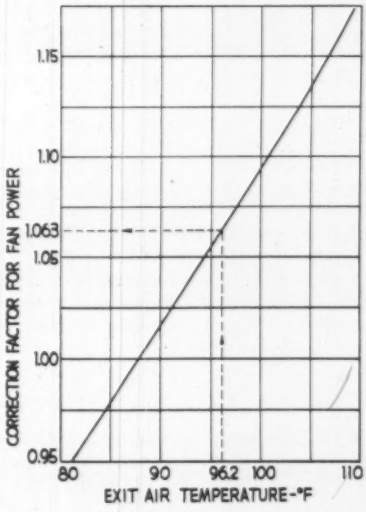
Fig. 1 Schematic view of open and closed circulating water cycles. The open cycle makes maximum use of existing circulating water facilities, and requires only a minor investment in piping, valves, and booster-pump capacity. But the more costly closed cycle permits higher water velocities in the condenser, due to freedom from condenser-tube erosion. This gives an improved station heat rate. Fig. 2 Graphical integration method in determination of value of KaV/L. This common denominator can also be calculated by a step method, such as Gauss's rule or Simpson's rule. Fig. 3 Constant approach lines, calculated for a 15 F range and a 75 F wet-bulb temperature. The author's company published 477 of these curves in 1943. Fig. 4 Fan-power requirements for components of a typical counterflow, induced-draft cooling tower. With the exception of the pressure drop caused by rain, each component has a certain velocity head. Fig. 5 The curves in Fig. 4 can be translated to the common denominator of L/G and combined with the thermal performance. Here is the combination of thermal and fan-power characteristics to determine flow capacities of a tower. Fig. 6 If large variations in air density have to be considered, fan horsepower will have to vary accordingly. This curve shows a correction of fan-power requirements for changes in exit air temperatures.











have been used in Great Britain. There, the wet-bulb temperatures are generally lower, giving a greater difference between entrance and exit temperatures, and thus greater stack effect. Easier cooling keeps the tower size within bounds, and, with fuel costs many times higher, the elimination of fan power effects great savings. Differences in station loads, and in taxes, enter the calculation. Utilities, being publicly owned, are not taxed; they can use a lower capitalization rate, which favors equipment of high initial cost.

Tower Size

A cooling tower can have a large cross-sectional area with small fan-power requirements, approaching a natural draft tower as a limit, or a small cross-sectional area with large fan-power requirements. Similarly, height and pumping head can be varied.

The optimum economic choice can then be made readily from among the many possible selections by balancing initial installation and operating costs.

The factors that affect cooling-tower performance are:

1 All conditions affecting thermodynamic behavior, such as packing configuration and spacing.

2 All conditions affecting air flow through the tower, such as type of fill rack used, fan efficiency, draft eliminator design, air-inlet louver design, and design of plenum chamber below fan deck.

3 All conditions affecting the entering air, such as recirculation, external heat sources, and restricted free area around the tower.

Items 1 and 2 must, of course, be considered together, since they are interdependent. The purchaser can best compensate for the factors under item 3, which are beyond the control of the cooling-tower manufacturer, by adding the estimated increase in wet-bulb temperature to the design condition. Recirculation of the cooling tower on itself is allowed for by the manufacturer.

The thermal duty required of a cooling tower can most readily be put on a common ground by using the inverse of the enthalpy potential between the water and the cooling air. This method makes it possible to translate all the possible variations in range, wet-bulb temperature, approach and L/G[4] to one common denominator, namely KaV/L. The theoretical proof for the validity of this method has been shown by many authors, and is accepted by most manufacturers (11, 12). The value of this thermal duty in terms of the tower characteristic of KaV/L can be calculated by various means. The differences in the methods of calculation are not caused by a difference in theory, but one of obtaining the integral in the expression

$$\frac{KaV}{L} = \int_{T_1}^{T_2} \frac{dT}{H' - H}$$

which can be integrated graphically, Fig. 2, or by a step method such as Gauss's rule or Simpson's rule, and still remain correct in a generalized way. Instead of using step methods of integration some authors have assumed an equation which fits the enthalpy of the air versus wet-bulb temperature curve for a limited range of temperatures (13).

The values of KaV/L for a range of operating conditions were put on 477 curves and published by the author's company, in 1943. The maximum deviation from the true value of KaV/L is in the order of 5 per cent with the majority of values well within this limit. A typical curve is illustrated in Fig. 3. The use of these curves not only reduces calculating time materially, but gives a good visual impression of the effects that changes in design conditions have on the performance.

(The author then derives formulas for the thermal performance of towers, and for fan power and exit temperature, Figs. 4, 5, 6. Examples are given, showing how an economic choice can be made between possible towers, starting with a tower of certain size and fan power, and comparing it with a larger, greater-first-cost tower with lesser fan-operating cost.)

Acknowledgment

The author wishes to express his appreciation to Mr. J. Arman for many of the data used to describe the hyperbolic cooling towers, and to Mr. D. E. O'Neil for his advice in the preparation of this paper.

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[4] Nomenclature: L is water mass flow, lb per hr per sq ft of ground area; G is air mass flow, lb dry air per hr per sq ft of ground area; K is over-all transfer coefficient, lb per hr per sq ft (lb water per lb dry air); V is active tower volume, cu ft per sq ft ground area; a is area of transfer surface per unit of tower volume; H is enthalpy of cooling-air stream, Btu per lb dry air; H' is enthalpy of saturated air at water temp, Btu per lb dry air.

It took centuries of experiment and thought.
Here is the story of the men whose inquiring minds solved the mystery of heat.

...adventure...in...science...

By J. H. Keenan,[1] Fellow ASME, Massachusetts Institute of Technology, Cambridge, Mass.

The first and second laws of thermodynamics as first stated by Rudolf Clausius in 1850:

First law—For a cyclic process in any closed system, the net work is proportional to the net heat.

Second law—The effects of a direct heat interaction between two bodies cannot be completely undone.

THE history of classical thermodynamics is an example of how the human mind wrestles with the problem of discovering and stating new principles. The discovery of a new scientific principle requires a new language which must be tailored to the needs of the new thought.

The first and second laws of thermodynamics were first clearly stated by Rudolf Clausius in 1850. He used three concepts, namely, work, temperature, and heat, which are so essential to thermodynamics that the history of the development of that science is in large measure the story of the development of these concepts. Work and heat are interactions between closed systems—closed in the sense that matter cannot enter or leave them. Work is an interaction such that the sole effect external to one of the systems is (or could be without alteration in the process within that system) the rise of a weight. Heat is an interaction resulting from a difference in temperature of the systems. Thus the concept of heat is dependent on the concept of temperature.

The First Measurement

One of the earliest attempts to measure temperature was made by Galileo about the year 1600. A friend of Galileo wrote in 1638: "Galileo took a glass vessel about the size of a hen's egg, fitted to a tube the width of a straw and about two spans long; he heated the glass bulb in his hands and turned the glass upside down so that the tube dipped in water contained in another vessel; as soon as the ball cooled down, the water rose in the tube to the height of a span above the level in the vessel; this instrument he used to investigate the degrees of heat and cold." Because of variations in atmospheric pressure, Galileo's thermoscope could be used for comparing temperatures only within short intervals of time.

Improvements in thermometers were made frequently throughout the seventeenth century. In 1653, the Frenchman Jean Rey devised a liquid-expansion thermometer with bulb and stem, although the stem was left open. In 1640, the Grand Duke Ferdinand II, of Tuscany, one of the founders of the Florentine Academy of Experiment, invented the sealed-stem alcohol thermometer. The uses to which these instruments were put included clinical (fevers), agricultural (incubation of eggs), and meteorological (weather).

The establishment of a scale inevitably raised the question of fixed points. Among indefinite proposals were the most severe summer heat and winter cold. More definite were body temperature, and freezing and boiling points. Even the melting point of butter was proposed as a fixed point. It appears that the Fahrenheit scale was originally designed in terms of zero for the freezing point of a saturated salt solution, 32 for the freezing point of water, and 96 for body temperature. Later, 32 and 212 were fixed upon for the freezing and boiling points of water. Celcius devised the scale with 100 units between these same fixed points but assigned zero to the boiling point and 100 to the freezing point.

Amonton in 1700 devised the constant-volume gas thermometer. This was essentially a scientific instrument as distinguished from the all-purpose instruments which preceded it. The reproducibility of its indications was not dependent upon the uniformity of a glass tube.

What Were They Measuring?

What was the objective of the inventors of the thermometer? They were trying to devise an instrument which would measure a quantity as yet undefined. The physiological sensations of hotness and coldness were involved, but they were inadequate. The thermometer would indicate the same temperature for a block of wood and a block of copper exposed to the same "severe winter cold," even though these two blocks seemed to be of quite different coldness by the sense of touch. An equi-

[1] Professor of Mechanical Engineering.

Based on a lecture delivered by the author at the University of London, England, in February, 1957.

...galileo.....clausius.....black.....celcius...

librium concept was doubtless involved—namely, that all bodies exposed to the same cold atmosphere would ultimately attain a uniform degree of coldness, evidence of the senses to the contrary notwithstanding.

A second concept played its part. That was the idea that temperature was a driving potential which caused some influence to pass from one body to another of unequal hotness or coldness. Thus when a body was taken from a warm room to the cold outdoors, its length began immediately to change. The difference in coldness between the body and its environment caused the environment to affect the body.

These concepts were tacitly, though not explicitly, understood. Without a clear statement of the concept, the indication of the instrument becomes confused with the concept. Thus Joseph Black in 1770 stated what he doubtless thought to be an axiom, but which was in reality the first criterion of a satisfactory thermometer: "All bodies communicating freely with one another and exposed to no inequality of external action acquire the same temperature as indicated by a thermometer."

What was it that passed from one body to another at different temperature and caused changes in temperature, volume, pressure, color, etc., of the bodies? Was it temperature itself that was transmitted? Francis Bacon as early as 1620, and the Florentine Academy a few years later, showed signs of distinguishing between this influence and temperature. It was more than a century, however, before the distinction was made sharp. In 1770, Joseph Black at the University of Glasgow showed, by mixing equal masses of different liquids of different initial temperatures, that the temperatures of the two substances often changed by radically different amounts. He got a similar result upon mixing equal volumes. He showed also that a large temperature change in a single-phase body produced no change at all in the temperature of a mixture of ice and water or of water and steam. Thus it was shown that temperature was not necessarily conserved or even transmitted.

The Science of Calorimetry

Black established the science of calorimetry and showed that a quantity other than temperature was conserved in his calorimetric processes. This was called heat or caloric. It could be made to pass from one body to a second, and then from the second to a third, leaving the second finally unaffected.

We can now see that Black's experiments were of the kind in which the work of the system is fixed by the end states of the process: they were mostly at constant pressure or at constant volume. His contemporaries, unaware of this restriction, built upon his work a general conservation principle which has come to be known as "the caloric theory."

Although it never attained the dignity of a science, the caloric theory had a troubled existence of about three-quarters of a century. It proved to be so useful in calorimetry that vestiges of it are found in contemporary scientific literature. For example, virtually every textbook on heat transfer states that heat may be transferred by conduction, radiation, *or convection*. In the thermodynamic sense of heat, convection is not a heat interaction.

A Subtle Fluid

According to the caloric theory, caloric or "matter of heat" was an all-pervading subtle fluid which could be neither created nor destroyed. This idea was in tune with its era, which was an age of subtle fluids like electricity and phlogiston. Probably no authoritative statement of the caloric theory ever existed. A fairly complete statement is contained, however, in the following postulates of William Cleghorn:[2]

1 Caloric is an elastic fluid the particles of which repel one another strongly.

2 Particles of caloric are attracted by particles of ordinary matter in different degrees for different substances and different states of aggregation.

3 Caloric is indestructible and uncreatable.

4 It is either sensible or latent. Latent caloric is caloric which has combined chemically with particles of solid to form liquid or of liquid to form vapor.

5 Caloric has weight.

These postulates were ingeniously contrived to account for certain observed phenomena. Postulate 1, accounts for expansion and contraction upon heating and cooling; 2, variations of specific heat capacity; 3, calorimetry; 4, latent heat; and 5, the gain in weight of certain metals when heated (calcined) in the presence of air. The plausibility of such postulates prompted Joseph Black, who was a dedicated experimentalist and a skeptic regarding all theories, to say that "such an idea of the nature of heat is the most probable of any I know."

The Unanswered Question

The gap in the armor of the caloric theory was the heating effect of friction, a phenomenon so common that it seems incredible that any theory of heat which did not provide for it should ever have been seriously entertained. John Locke in the 17th century said, "the axle trees of carts and coaches are often made hot, and sometimes to a degree that it sets them on fire, by the rubbing of the naves of the wheels upon them."[3]

In an attempt to close this gap some said that friction reduced the attraction between caloric and material particles and so freed the caloric to flow to the surroundings.

Count Rumford, the strange expatriate American genius, conducted a relentless campaign against the caloric theory with all the skill of a military strategist. He showed, first, that caloric is weightless; second, that metal which has been subjected to friction has the same heat capacity as the native metal; and, third, that the ability of brass to produce heat by rubbing is inexhaustible. This last point, which he demonstrated by his famous cannon-boring experiments in his arsenal at Munich, proved to be the crucial one. In the words of Rumford, "the source of the heat generated by friction in these experiments, appeared evidently to be inexhaustible. It is hardly necessary to add that anything which any insulated body, or system of bodies, can con-

[2] Inaugural dissertation at the University of Edinburgh, 1779.

[3] Quoted from "Elements of Natural Philosophy," by John Locke (1722) in "The Early Development of the Concepts of Temperature and Heat," by Duane Roller, Harvard University Press, Cambridge, Mass., 1950.

. . grand duke frederick II. . . . cleghorn. . . . bacon . .

tinue to furnish without limitation cannot possibly be a material substance."

The generation of heat through friction was studied subsequently by several experimenters. The greatest of them was James Prescott Joule of Manchester, England, who distilled from his experiments a new principle to supplant the caloric theory.

A Mechanical Theory

While those who thought in terms of calorimetry devised the caloric theory, those who thought in terms of friction, compression, and expansion devised a mechanical theory of heat. Francis Bacon averred that "heat itself, its essence and quiddity, is motion and nothing else." Boyle, Hooke, and Locke shared this view and thought of hotness as being motion or tremor in the small particles of matter or in particles of a subtle fluid pervading matter.

Leibnitz in 1695 made this point of view a quantitative one when he stated that, in the inelastic collision of bodies, the *vis viva* (the kinetic energy) was not lost but was converted from motion of the gross mass into motion of the minute particles of which the mass was composed. Rumford felt that his cannon-boring experiments confirmed the equivalence of "motion" and "heat."

The Work-Heat Relation

Joule brought this mechanical theory to fruition. He showed that certain effects which were typical heat effects could be produced by work alone. His typical heat effect was the raising of the temperature of a pound of water through one degree of the Fahrenheit scale. He showed that this effect could be produced by 838 ft-lb of work alone through the agency of an electromagnetic engine which was surrounded by water. Next, he rotated a perforated piston in a jar of water, then a paddle wheel in water, then a paddle wheel in sperm oil, and then he rubbed two cast-iron surfaces together under water. The work required for his selected task varied from 700 to 900 ft-lb. He eventually selected 772 for his best value.

Through the mechanical theory of heat, Joule developed a clear concept of something stored in bodies which was conserved in spite of work and heat interactions between the bodies. For want of a language he stated his postulates with difficulty. He had none of the terms energy, kinetic energy, potential energy, work, or property at his disposal. Nevertheless, he made it clear that the sum of what we, today, call the kinetic and potential energies of all parts, large and small, of an isolated system of bodies is always the same. Work and heat interactions were merely the redistribution of this sum among the large bodies.

In a lecture[4] which he delivered in May of 1847 he made these points clear. He said, "The force expended in setting a body in motion is carried by the body itself, and exists with it and in it, throughout the whole course of its motion. This force possessed by moving bodies is termed by mechanical philosophers *vis viva*, or *living force*. . . When a weight falls to the ground, it has been generally supposed that its living force is absolutely annihilated. . . .without the production of any permanent effect whatever. We might reason, a priori, that such absolute destruction of living force cannot possibly take place, because it is manifestly absurd to suppose that the powers with which God has endowed matter can be destroyed any more than that they can be created by man's agency; but we are not left with this argument alone, decisive as it must be to every unprejudiced mind. . . . Experiment. . . .has shown that, wherever living force is apparently destroyed, an equivalent is produced which in process of time may be reconverted into living force. This equivalent is *heat*. . . . The most frequent way in which living force is thus converted into heat is by means of friction. . .all bodies, solid or even liquid, rubbed against each other are invariably heated, sometimes even so far as to become red hot. . .the quantity of heat produced is invariably in proportion to the. . . . living force absorbed.

"A few words may be said, in conclusion, with respect to the nature of heat. Heat must. . .consist of either living force or of attraction through space. In the former case we can conceive the constituent particles of heated bodies to be, either in whole or in part, in a state of motion. In the latter we may suppose the particles to be removed by the process of heating, so as to exert attraction through greater space.

". . .Wherever living force is *apparently* destroyed, whether by percussion, friction, or any similar means, an exact equivalent of heat is restored. The converse of this proposition is also true, namely, that heat cannot be lessened or absorbed without the production of living force, or its equivalent attraction through space. Thus for instance, in the steam-engine it will be found that the power gained is at the expense of the heat of the fire; that is, that the heat occasioned by the combustion of the coal would have been greater had a part of it not been absorbed in producing and maintaining the living force of the machinery. It is right, however, to observe that this has not as yet been demonstrated by experiment."

In these remarks Joule is using the term "heat" for a property which we should now call "energy." He is stating a principle of conservation of the sum of "heat," the living force and attraction through space of constituent small particles, and living force and attraction through space of large masses. He points out that the conversion from the macroscopic manifestation to the microscopic has been frequently observed in frictional and other processes. He asserts that the reverse conversion occurs in steam engines. J. R. Mayer, a German physician, had made a similar observation in 1842.[5] Joule claims that he has experimentally observed this reverse conversion in the production of work by an electrolytic cell. William Thomson (later Lord Kelvin) was unable to agree with Joule on this point a year later.

Joule failed to state the first law of thermodynamics. Instead, he stated the conservation principle of the dynamical theory of gases. He did not clearly distinguish between "heat" the property, and "heat" the interac-

[4] Joule's Scientific Papers, Physical Society of London, vol. 1, 1884, p. 265.

[5] J. R. Mayer, "Bemerkung über die Krafte der Unbelebten Natur," *Annalen der Chemie und Pharmacie*, Bd. XLII, 1842, pp. 233–240.

tion. This defect in language pervaded the literature.

In the meantime, however, Carnot had stated a principle in terms of the heat interaction. In his paper entitled "Reflections on the Motive Power of Heat,"[6] which he published in 1824, Carnot made four distinct contributions to the new science. First, he introduced the concept of the cycle, the process which leaves no effects within the closed system. Second, he discussed for the first time a net heat interaction as distinguished from changes in the "heat contained in a system." Third, he introduced the concept of reversibility and of reversible processes as a class. Fourth, he stated a new principle concerning the maximum work obtainable from heat interactions.

Carnot's principle was, in effect, the second law of thermodynamics. The irony of the situation was that he had discovered the second law before the first had been discovered. This failure to observe the proper numerical order was to have grave consequences. It meant that Joule could not accept Carnot's principle, and Kelvin could not accept Joule's principle. Judging from the unpublished notes left by Carnot, the confusion would have been resolved more than a decade sooner than it was had it not been for Carnot's untimely death from cholera in 1832 at the age of 36.

Carnot's principle is the following: "The motive power of heat is independent of the agents employed to realize it; its quantity is fixed solely by the temperatures of the bodies between which is effected, finally, the transfer of caloric. We must understand here that each method of developing motive power attains the perfection of which it is susceptible."[7]

Carnot showed that the perfection required was attained by a fluid system executing a Carnot cycle. He attempted to prove his principle in terms of the caloric theory which required that the net heat interaction of a cycle must be zero. He explained, by an analogy, the production of work when heat flowed into his cyclic engine at high temperature and out, undiminished, at low temperature. His analog was the hydraulic engine or water wheel which receives a stream of water at a high level and discharges it, undiminished, at a low level and produces work.

His proof of his principle consisted of showing that, if any cycle were more efficient in producing work from heat than the reversible cycle, then that cycle in combination with the reversed reversible cycle would produce work without net effect on the cyclic devices or the heat reservoirs with which they interacted. Carnot says "this would be not only perpetual motion, but an unlimited creation of motive power without consumption either of caloric or of any other agent. Such a creation is entirely contrary to ideas now accepted, to the laws of mechanics and sound physics. It is inadmissible."

This argument was an attempt to prove the essence of the second law by reference to a rudimentary form of the first law. Carnot had misgivings about the caloric theory upon which he based his argument. Concerning this theory he said: "To deny it would be to overthrow the whole theory of heat. . . . Many experimental facts appear almost inexplicable in the present status of the theory."

Kelvin in 1848 was on the horns of a dilemma. He was conversant with the works of Carnot and of Joule, and he had great respect for both. Carnot's hydraulic analogy was irreconcilable with Joule's concept of the interconvertibility of heat and work. Kelvin said: "The conversion of heat into mechanical effect is probably impossible, certainly undiscovered. . . This opinion seems to be nearly universally held. . . A contrary opinion, however, has been advocated by Mr. Joule of Manchester, some very remarkable discoveries which he has made. . .seeming to indicate an actual conversion of mechanical effort into caloric. No experiment is adduced in which the converse operation is exhibited; but it must be confessed that as yet much is involved in mystery with reference to these fundamental questions of natural philosophy."

Again, he says, "No operation is known by which heat can be absorbed into a body without . . . producing some alteration in its physical condition." This comment sheds some light on Kelvin's difficulty. As proof of interconvertibility of heat and work, he is asking for a process which is the reverse of the generation of heat interaction by friction. That is, if a body can give heat to an isothermal environment without change in the condition of the body, by virtue of the absorption of work into the body through friction, then should it not be possible for a body to give work to its environment, without change in the condition of the body, by virtue of heat absorbed? We know now that this phenomenon cannot be realized for a *single* heat interaction.

The gnawing doubt, however, persists in Kelvin's query, "When 'thermal agency' is thus spent in conduction of heat through a solid (from high temperature to low), what becomes of the mechanical effect it might produce? A perfect theory of heat imperatively demands an answer to this equation." Again, he speculates, "It might appear, that the difficulty would be entirely avoided, by abandoning Carnot's fundamental axiom; a view which is strongly urged by Mr. Joule . . . If we do so, however, we meet with innumerable other difficulties—insuperable without further experimental investigation, and an entire reconstruction of the theory of heat from its foundation. It is in reality to experiment that we must look."

It was Clausius who in 1850[8] separated the tangled threads of thought into the relevant and the irrelevant, the true and the false. After reviewing the work of Carnot and Joule and the perplexities of Kelvin, he suggests that the answer lies in the mechanical theory of heat. He says "I do not think the difficulties are so serious as Thomson (Kelvin) does. . . . . It is not at all necessary to discard Carnot's theory entirely. . . .it has to some extent been conspicuously verified by experience. . . .the new method does not stand in contradiction to the essential principle of Carnot, but only to the subsidiary statement *that no heat is lost*, since in the production of work it may very well be the case that at the

[6] "Reflexions sur la Puissance Motrice du Feu et sur les Machines," by N. L. S. Carnot, Bachelier, Paris, 1824.

[7] "Reflections on the Motive Power of Heat," by S. Carnot, translated by R. H. Thurston, ASME, New York, N. Y., 1943.

[8] "On the Motive Power of Heat, and the Laws Which Can Be Deduced From It For The Theory of Heat," by Rudolf Clausius, Poggendorff's Annalen, vol. 79, 1850, pp. 376, 500.

same time a certain quantity of heat is consumed and another quantity transferred from a hotter to a colder body, and both quantities of heat stand in a definite relation to the work that is done."[9]

Clausius states the first law as follows: "In all cases in which work (*arbeit*) is produced by the agency of heat, a quantity of heat is consumed which is proportional to the work done; and, conversely, by the expenditure of an equal quantity of work an equal quantity of heat is produced." From this he proceeds to the observation that the *total heat* (gesammtwärme) of a body is not fixed by the state of the body, because in a cycle the net heat may not be zero. His discussion then becomes complicated by use of the terms *free heat*, *latent heat*, and *internal work*. Despite these complexities, it is clear that Clausius was thinking in terms of cycles when he stated the first law. Internal work was, apparently, a change in the potential energy of separation of the ultimate particles of matter. The amount of this in any process he says presents a difficulty because it is unknown. He credits Carnot with overcoming this difficulty: "To avoid this difficulty, Carnot employed the ingenious method already referred to of allowing the body to undergo its various changes in succession, which are so arranged that it returns at last exactly to its original condition. In this case, if *internal* work is done in some of the changes, it is exactly compensated for in the others, and we may be sure that the *external* work, which remains over after the changes are completed, is all the work that has been done."

In discussing the Carnot cycle in a permanent gas he writes:

$$"dQ = dU + AR\frac{a+t}{v}\,dv$$

in which U is an arbitrary function of v and t." Since he had previously stated "the combined laws of Mariotte and Gay-Lussac" in the form

$$pv = R(a + t)$$

it follows that his definition of dU was simply

$$dU \equiv dQ - Apdv$$

Thus he defined a new property which was a consequence of his first principle. Kelvin was to name it, later, the *mechanical energy*.

This tour de force by Clausius took Kelvin off the horns of his dilemma. Within a year of the publication of Clausius' paper, Kelvin wrote a paper of more than 150 pages entitled "On the Dynamical Theory of Heat."[10] He first acknowledges Carnot's contribution of the cycle. He then states the first law, which he attributes to Joule, and the second, which he attributes to Carnot and Clausius.

He gives the name *mechanical energy* to the property which Clausius had denoted by the symbol U. Like Clausius, he expressed the increment in this property as the difference between a heat interaction and a work interaction. Later Gibbs shortened the term *mechanical energy* to *energy*.

In a paper with Joule in 1852 Kelvin proposed the thermodynamic temperature scale that now bears his name. From this point Clausius proceeded to the definition of a property characteristic of the second law as the property energy was of the first law. He called it *entropy*.

The foundations of classical thermodynamics were thus laid before 1860. The process consisted of the development of the concepts of temperature, heat interaction, work interaction, and property, as well as interconvertibility of heat and work. The problems of exposition of a science persist, however, long after the science is firmly founded. The vocabulary of thermodynamics was still rudimentary when Clausius stated the principles. The term *work*, though introduced by Clausius, was not adequately defined until Gibbs attended to it in a footnote in 1873.[11] We may paraphrase his definition by saying that the work done by a body undergoing a process is measured by the magnitude of the weight that could be raised a given distance, no other permanent change being produced in external bodies.

The term *heat* still gives us trouble. It is not uncommon today to see statements like that of Kelvin in 1878: "Now that we know heat to be a mode of motion and not a material substance."[12] This seems to suggest, despite Kelvin's introduction of the term mechanical energy for the property U of Clausius, that heat is a property. It was not until the 1890's that Poincaré[13] proposed that the term *heat* be reserved for any interaction between systems resulting from a temperature difference. He also pointed out that thermodynamics is a science of macroscopic systems, and that the mechanical theory of the energy of an ensemble of microscopic particles was essentially irrelevant.

Summary

We have traced the development of a language consisting of a few words necessary to the statement of two new principles. Enmeshed in the language we find the principles themselves. The first law is implied in the interrelationships of the words energy, property, heat, and work. Similarly, the second law is implied in the interrelation between the words temperature and heat. This complex of meaning was born of an intellectual labor which, reckoned from Galileo's thermoscope, involved a score of great minds and nearly three centuries of time. It reached its maturity in the work of Gibbs on the equilibrium of heterogeneous systems. It has been extended in this century to new areas of usefulness by the third law of Nernst and the reciprocal relations of Onsager.

[9] From translation by W. F. Magie in "The Second Law of Thermodynamics," Harper, 1899.

[10] Transactions, Royal Society of Edinburgh, March, 1851, and *Philosophical Magazine*, vol. 4, 1852.

[11] "A Method of Geometrical Representation of Thermodynamic Properties of Substances by Means of Surfaces," by J. W. Gibbs, *Trans. Connecticut Academy*, vol. II, 382, Dec., 1873. "The Collected Works of J. Willard Gibbs," vol. 1, Longmans, 1931, p. 51.

[12] Article for the Encyclopaedia Britannica.

[13] "Thermodynamique," by H. Poincaré, Gauthier-Villars, Paris, 1898.

A Research Sawmill

By William K. Stamets, Jr.[1] and Kenneth C. Compton[2]

SAWMILLS specifically for research purposes in the United States and Canada are few in number. At present, only four sawmills in these two countries meet the design requirements for research in other fields than quantitative and qualitative studies of lumber production. These mills, two of which are associated with forest-products laboratories, and two at educational institutions, are designed to permit studies of power requirements under various conditions of species and characteristics of logs, saw characteristics, and operating variables. At least one of these mills, that at the State University College of Forestry at Syracuse University, is also designed to serve two other purposes—initiating students into the operation and maintenance of small circular sawmills, and preparation of material for the use of other individuals within the college organization.

Research Facilities at Syracuse

Because there are so many more circular sawmills than bandmills in operation, the research sawmill at Syracuse uses a circular headsaw of a design derived from research mills already in operation at the United States Forest Products Laboratory at Madison, Wis., and the Canadian Forest Products Laboratories at Ottawa, Ontario. Special features were incorporated after consultation with sawmill-manufacturing companies and electrical-equipment manufacturers.

The carriage, a standard Enterprise Company No. 34 unit, is equipped with four headblocks, each with taper sawing knees and duplex dogs. Thus practically any shape of log or cant may be held securely for any series of special testing procedures or for preparing specially sawn material for research projects of other individuals within the College. The setworks are double-acting, and, according to the manufacturer, accurate to $^1/_{64}$ in. The carriage drive, which is a conventional drum-and-cable unit, is actuated by two separate sources of power. One is a Westinghouse 15-hp d-c mill motor coupled to a speed reducer and clutch in the end of the cable drum, and controlled at the sawyer's stand by a series of relays. These vary the voltage, thereby moving the carriage forward at speed intervals of 30, 100, 150, 200, 250, 300, 350, and 400 fpm. An auxiliary brake stops the carriage and holds it at rest. Originally, the electrical carriage drive was to have an infinite-speed control, but the final choice was an assigned-speed control with greater utility for research purposes. The other carriage drive derives its power from the headsaw mandrel. By means of a belt drive, a steel friction pulley, two leather friction pulleys, and a shaft and gears on the cable pulley, the carriage may be controlled as in the average small sawmill.

The general layout of the sawing equipment at Syracuse can be seen in Fig. 1. This shows the headsaw, carriage, and carriage drive just discussed. Also shown are the log deck, the main-headsaw drive motor, sawyer's control station, lumber-handling facilities, a variable-speed edger, the instrument desk, and a trim saw with a slab conveyer. The equipment is arranged to conserve space and yet provide a desirable condition for research and class instruction. Dry kilns, which require a suitable loading area in front, are at the north wall. A separate 16 × 55-ft Motor-Generator Room houses a 5-unit 150-hp motor-generator set, and a centralized control panel containing all motor starters, relays, and controllers, and a 21-in. 4200-cfm sawdust blower.

A 15-hp mill-motor carriage drive is located in a pit. The main-headsaw drive is a Westinghouse 75-hp constant-speed 1200-rpm 230-volt d-c forced-ventilated shunt-wound motor adjustable for 300 to 1200 rpm which is flexibly coupled to the saw-mandrel extension through a Baldwin SR-4 torquemeter. A saw-speed tachometer is provided. It should be noted that full horsepower is attained only at top speed with this type motor. Because much sawing is done in the neighborhood of 500 to 600 rpm, a two-speed gear box is contemplated to provide full motor horsepower at these speeds.

A number of electrical and mechanical safety features are provided in the mill design. First, to prevent possible overheating of the d-c motors, all forced-ventilation blowers are interlocked with their respective motor controls so that the blowers must be operating before the motors can be started. Second, safety relays are provided for protection against field loss, low voltage, thermal and instantaneous overloads, and power failure. In case of power failure or carriage overtravel, the log-carriage drive motor stops automatically by regenerative braking which is augmented by a mechanical holding brake. The carriage overtravel is determined by the location of two safety-flag limit switches—one for slowing down, the other for stopping—near each end of the trackway.

Table 1 Operating Variables and Electric Sensing Equipment for Research Sawmill

Variable	Sensing instrument
Saw speed, 0 to 1500 rpm	G. E. BC-46 tachometer
Saw-mandrel torque, 0 to 12,000 in-lb	Baldwin Model A-12 torquemeter, type SR-4, Fig. 2
Saw position, degrees from adjustable reference	Cam and microswitch on saw mandrel, Fig. 2
Saw-bearing reactions, lb	Baldwin SR-4 single-strain gages mounted in special headsaw test bearing, Fig. 3
Carriage travel, ft (0 to 32 ft max)	Cams on backside of carriage mounted at 1-ft intervals actuating microswitch on trackway
Cable pull, 0 to 5000 lb	Baldwin SR-4 load cell, type U-1 mounted between trackway and sliding sheave plate

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Instrumentation

Instrumentation for the research sawmill at Syracuse is much the same as that used in the Forest Products Laboratory of Canada at Ottawa, and it is expected that this will result in a certain amount of interchangeability of test data and reports between the two countries. The important variables measured and the means employed are shown in Table 1.

The strain-gage outputs are amplified by four Brush Model BL-360 portable strain amplifiers and two Brush Model BL-202 double-channel oscillographs. Two event markers are provided on one of the oscillographs to reveal the carriage-travel interval and the saw-mandrel position or speed. An event marker on the second oscillograph is provided as a means to co-ordinate data or for some future data requirement. Three of the amplifiers and the two recorders are housed in a special dust-tight instrument desk with a clear-plastic hinged top. The amplifiers are interconnected and well grounded to prevent amplification of stray signals and cross oscillation. Means for connecting, disconnecting, and monitoring the gage outputs are provided by a double-row jack panel. A voltmeter measuring the tachometer output and calibrated in saw rpm is also provided.

The equipment and instruments described permit simultaneous recording of all the operating variables listed in Table 1. In addition, it is a simple matter to obtain motor-horsepower demands concurrent with these variables either by calculation or by a horsepower meter. For sawing various species of timber, say all of one size, it is possible to get comparative data on energy requirements, optimum saw speeds, carriage feed rates, saw forces, and bearing reactions. It would be helpful to have more published data on the effect that each one of these characteristics has on the sawing operation as a whole. Another application would be the testing of new-style saw bits and blade designs.

Of interest to sawmill builders would be a quantitative investigation of the critical speeds and dynamic behavior of various saw-mandrel-and-drive combinations. The effects these have on saw flutter and mandrel torque could be checked.

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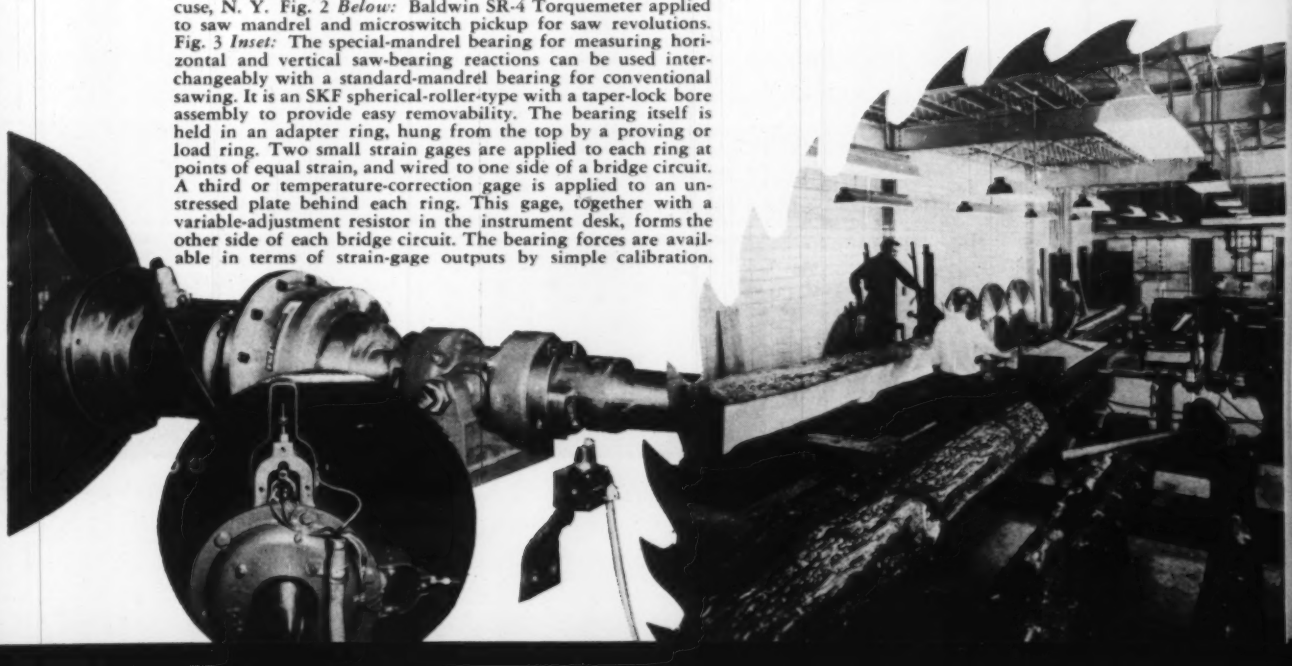
Fig. 1 ***Right:*** **Research sawmill installation at the Hugh P. Baker Laboratory, State University College of Forestry, Syracuse, N. Y. Fig. 2** ***Below:*** **Baldwin SR-4 Torquemeter applied to saw mandrel and microswitch pickup for saw revolutions. Fig. 3** ***Inset:*** **The special-mandrel bearing for measuring horizontal and vertical saw-bearing reactions can be used interchangeably with a standard-mandrel bearing for conventional sawing. It is an SKF spherical-roller-type with a taper-lock bore assembly to provide easy removability. The bearing itself is held in an adapter ring, hung from the top by a proving or load ring. Two small strain gages are applied to each ring at points of equal strain, and wired to one side of a bridge circuit. A third or temperature-correction gage is applied to an unstressed plate behind each ring. This gage, together with a variable-adjustment resistor in the instrument desk, forms the other side of each bridge circuit. The bearing forces are available in terms of strain-gage outputs by simple calibration.**



Abstracts and Comments Based on Current Periodicals and Events

D FREIDAY
Assistant Editor

BRIEFING THE RECORD

Thermal Computers

AFTER five years of research, thermal analog computers for performing arithmetic, trigonometric, and operational computations are a reality. The units can be designed for any a-c or d-c voltage with power requirements ranging from 100 milliwatt to 1 watt and with the input circuit isolated from that of the output.

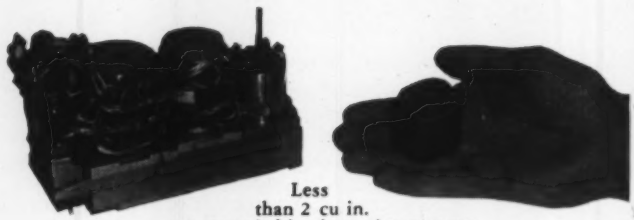
Less than 2 cu in. in size, the thermal computer units can replace servomechanisms in many applications and have wide possibilities in the field of computing and control.

Thermal computers are rugged, being unaffected by shock or vibration; are relatively insenstive to ambient temperature, and completely static, requiring no mechanical parts. They can be designed for a wide variation in time delay—0.3 sec to 2000 sec—and, when an external amplifier is used with feedback, the time delay can be varied over a much larger range.

Analog computations utilizing heat transfer were invented at the Arma Division of American Bosch Arma Corporation, Garden City, N. Y., early in the 1950's. They were first described in an article by Gareth M. Davidson in *Electrical Manufacturing*, June, 1954. The present state of the art is described in an article by George M. Gedney in a recent issue of *Arma Engineering*.

Fundamentally, the thermal element is composed of heater and sensor elements designed to be of low mass, in close proximity to each other, thereby yielding fast response times to input-signal variations and a low temperature gradient between them. Usually two thermal elements are used in a common can to form a thermal unit, thereby providing all of the necessary parts in a single package. Any combination of multiple heaters may also be used with single or multiple sensors in a common can to "pool" information from several sources or to direct it to several receivers.

The sensors, in intimate association with their respective heaters, will "follow" the temperature variations produced in the heaters, the voltage output being proportional to the power input. By means of appropriate circuitry, multiplication and division of analog voltages can be performed readily.



Less than 2 cu in. are occupied by thermal computers, as compared with mechanical unit at *left*

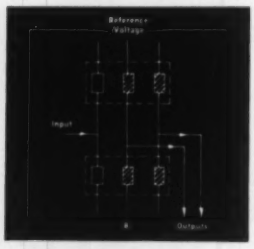
In the accompanying diagram, two sensing elements are used with each heater together with a high-gain amplifier. The inputs are voltages X, Y, and Z. Due to the high gain around the loop, the voltage at a is equal in magnitude to X with very little error. The signal power for the heater element is supplied by the amplifier. Mathematically the circuit may be described as follows: For the first pair of sensing elements, let K = bridge-unbalance factor, $A = -X = KZ$, $K = X/Z$. For the second pair of sensing elements, the unbalance factor is the same. The output voltage $E_0 = YK = -XY/Z$. It can be seen that both multiplication and division are performed simultaneously. Using similar circuitry, the operations of squaring or square root can also be performed.

The advantages in size obtained using thermal units as compared to servomechanisms for a multiplying application can be seen from the photograph. The simplicity and reliability of computing are also improved, and there are reductions in weight and cost.

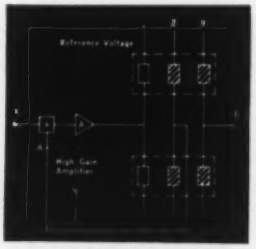
The accuracy of computing with thermal elements is limited at the present time to ±1 per cent. However, until further information is obtained it is reasonable to consider that this accuracy can be increased to 0.1 per cent or better. The ultimate accuracy of servomechanisms, on the other hand, is of the order of 0.01 per cent at present and requires the use of ultra-precision components and refined techniques. Many intermediate computations need not be better than 1 per cent accurate, and this is often sufficient for all calculations.

Thermal unit with one heater and one sensor

Unit with one heater and two sensors



Basic multiplication and division circuit



AEC's Three-Year Record

"No OTHER major scientific discovery has ever before been applied so quickly to so many practical uses," states the U. S. Atomic Energy Commission in the July-December, 1957, report on "Progress in Peaceful Uses of Atomic Energy."

Departing from the usual six-month-period coverage, the report is a record of three years of progress. Since 1953, the report states, and especially since passage of the Atomic Energy Act of August 30, 1954, the United States has advanced steadily in the development of the various applications of nuclear sciences and technologies.

Since 1953, the Commission and its contractors have completed design and construction of six experimental power reactors; industry with its own funds put a seventh in operation; an eighth constructed for the Army has civilian uses. Further, an experimental reactor is operating with a new type of core. This is in addition to the successful demonstration of three nuclear-powered submarines, and the major program to build a nuclear-powered Navy.

Expenditures or obligations by the Federal Government for research and development and construction of civilian and military power and propulsion reactors are estimated at more than $500 million for the fiscal year ending June 30, 1958. Estimates were that private industry was spending about $64 million on civilian power reactors during the same period.

Commission tabulations show that 46 power reactors are under construction—36 of them for the armed services. Their capital costs are high—five civilian power reactors licensed by the AEC are valued at $233 million. Power reactors built or building range from 5000 to 180,000 electrical kw, and cost from $2.5 million to more than $70 million each.

There are 36 research, training, and test reactors, exclusive of 7 critical assemblies, being built at the present time.

There were 238 reactors operated or building in the United States as of December 31, 1957, and 67 were planned. Six months before there were 174 operated or building, and 93 planned.

The instrument industry—in 1948, a $4-million-a-year industry—reached $20 million in 1951-1952, and included some 80 companies manufacturing some 250 types of instruments. It is estimated that in 1957 industry sales totaled some $35 million by about 120 companies manufacturing approximately 1500 types of instruments, detectors, special components, and accessories.

The use of radioisotopes is estimated to be currently returning to American industry annual savings equivalent to some 7 per cent on the $7 billion of tax money invested by the Federal Government in atomic energy plant and facilities. The estimated $500 million and more a year in industrial savings come from speeded-up manufacturing operations, improvement of products and industrial processes, and in savings through uniformity of quality and other means. This is a 400 per cent increase since 1953 when savings were estimated at $100 million.

The industrial organizations presently authorized for radioisotope utilization represent only about six tenths of 1 per cent of the total number of manufacturing and mining concerns counted by the Bureau of the Census. AEC studies indicate that at least 8 to 10 per cent of the firms can profitably use radioisotopes.

Radiation stimulation of chemical reactions is a growing industrial use of atomic energy. Chemical reactions "triggered"—in a sense, catalyzed—by penetrating atomic particles include polymerization, cross linking, halogenation, and oxidation.

Physical chemists find isotope tracers especially useful in fundamental studies of such natural phenomena as atom exchange, aging of precipitates, surface reactions, diffusion, vapor pressures, and thermodynamics.

The AEC's physical-research program expanded from a level of slightly under $43 million a year in fiscal years 1954 and 1955 to nearly $60 million in fiscal 1957, and a better than 40-per-cent increase in the number of research contracts between 1954 and 1957.

The fields of investigation and experiment under the physical-research program include physics, chemistry, metallurgy, mathematics, and computer development, and controlled thermonuclear reactions, and involve: all aspects of nuclear physics; the properties of elementary particles, the techniques, equipment, and machines involved in nuclear research; the physical, chemical, and metallurgical properties of materials of interest to the atomic energy program; the geochemistry and geophysics related to the finding of ore; and other radiation, chemical, physical, and engineering development studies.

The rare-earth elements, for example, have been studied because of the unusual similarities and differences that make them of interest for tailor-made alloys, and their applications in the atomic energy program. A number of rare-earth separation processes have already resulted and their engineering properties have been investigated.

Fundamental research on free radicals has not only led to the discovery of many new species, but has had practical application in the field of rocket fuels.

Research on materials has led to new ceramic fuel elements and new corrosion-resistant metals.

Static Control Switching

A STANDARD LINE of eight "switching reactors"—static-control components that utilize impedance changes in a magnetic device to switch a-c or d-c loads—has been introduced by the Control Division of Magnetics, Inc., Butler, Pa.

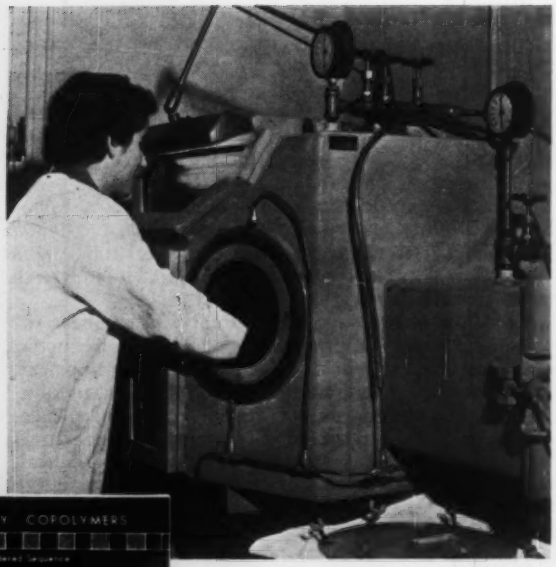
Switching action is performed in these control reactors without the use of the contacts or moving parts found in conventional relay systems, and without preamplification of the control signal. They are capable of some of the proportioning functions of vacuum tubes, and can replace transductors in some shunting applications.

The eight models are offered in four nominal volt-ampere ratings of 15, 75, 150, and 300 for switching either a-c or d-c loads. One family with these v-a ratings operates directly from nominal supply voltages, the other delivers standard load voltages.

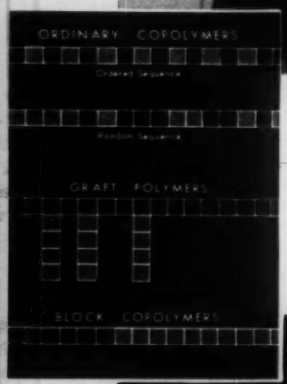
They can be used as basic control components to drive such loads as solenoid valves, motor contactors, magnetic clutches, and annunciator indicator, or alarm systems.

Multiple-purpose control coils enable the reactors to translate inputs to plain logic operations—AND, OR, NOT, and TIME DELAY—and with the addition of external positive feedback—MEMORY.

The switching reactors are explosionproof, having no spark, and are insensitive to extremely varying atmospheric conditions in plants. They have very long life, and the cores and windings are potted to make them virtually impervious to vibration and shock.



Preparing polymer samples in an inert atmosphere



Lowering a "weazel tube" into the pool of Battelle's research reactor

Graft Polymerization

Plastics, more generally known to chemists as polymers, are high-molecular-weight organic compounds produced by linking together many small units called monomers. Polymers may be built of units of the same kind or of a combination of dissimilar monomers. The former are known as homopolymers, the latter as copolymers. As illustrated, simple copolymers may have either a regular, ordered sequence of the two types of polymers, or the different polymers may be arranged in random order.

One of the most promising new methods for preparing plastics with unusual characteristics is "graft polymerization." Like the horticulturist who is able to graft apple scions to pear trees, the chemist can join chemically two or more dissimilar polymers, according to H. George Hammon in an article in the *Battelle Technical Review*.

The straight-chain linkage of monomers, with or without branches of units, provides materials known as "thermoplastics." These may be repeatedly softened with heat and remolded. A typical polystyrene chain may contain as high as 2000 units. Polymers produced by "cross-linkage" of monomers in three-dimensional fashion are infusible and are called thermosetting resins. Bakelite, a three-dimensional phenol-formaldehyde polymer, is a good example of such a resin.

In graft polymerization, one polymer forms a chain or backbone to which the second polymer attaches itself as branches. It has been known for years that grafting can be carried on by a number of methods including the utilization of free radicals (created by chemical and other means), ionic polymerization, and condensation or addition reactions. However, it is just being introduced into plastics technology. Grafting by irradiation is a recent discovery, not generally known until some three years ago.

Properties of graft copolymers depend to a large extent on the number and length of the branches. For this reason, grafting can be used to create tailor-made polymers possessing certain desired properties. They may possess characteristics similar to one of the pure components or entirely unique properties.

There are a number of methods of "grafting" described by Dr. Hammon. Certain types of treatment result in the decomposition of peroxide groups to form peroxy-free radicals attached to the polymer, which initiates grafting of the monomer to these sites.

Grafting may also be accomplished by modification of the usual polymerization procedures. Rubber may be dissolved in styrene monomer and the mixture polymerized with the aid of the usual peroxide initiators. During the polymerization, some of the styrene becomes grafted to the rubber. Similarly, in emulsion polymerization processes, one monomer (butadiene, for example) may be polymerized first, the second monomer (let's say styrene) is added, and the polymerization continued. Under these conditions much of the styrene can be grafted to polybutadiene. Graft polymers prepared by these methods may be used in molding resins, and are reported to contribute considerably higher impact strength to the resin than simple blends of polymers in the same proportions. Graft copolymers of rubber and methacrylate have improved tensile strength and fatigue resistance.

The concept of "living" polymers has been introduced

by M. Szwarc in which the polymer continues to grow as long as it has monomer "food." If the supply of monomer is exhausted, the growth is interrupted, although the living ends are potentially able to grow further if an additional amount of monomer is made available. Thus interesting block or graft copolymers were prepared by allowing the initial polymerization to consume the first monomer. A second, different monomer was then added and the polymerization continued. The polymers were terminated or "killed" by the addition of air or water.

Graft polymerization is proving economically feasible in a number of applications. The development of improved processes of varied types is likely to reduce costs considerably and encourage use of this technique.

Miniature Centralized Lubrication

"ACCUMITE," a new, low-cost, low-pressure, positive-displacement type of miniature lubrication system for use on machine tools, packaging, canning, labeling textile, and other similar types of machinery which have numerous bearings and limited installation space, has been announced by the Alemite Division of Stewart-Warner Corporation, Chicago, Ill.

Alemite Accumite centralized systems are specifically designed to efficiently lubricate industrial vehicles and machinery which were previously not considered for centralized systems for economical or structural reasons.

The heart of the system is a miniature metering valve, slightly larger than a lubrication fitting, which services each bearing individually. The Accumite valve delivers a specified amount of refinery-clean lubricant to each bearing connected in the system regardless of bearing clearance or distance of the bearing from the pump, and is specifically designed to eliminate lubricant drainage from the system when the machine is idle.

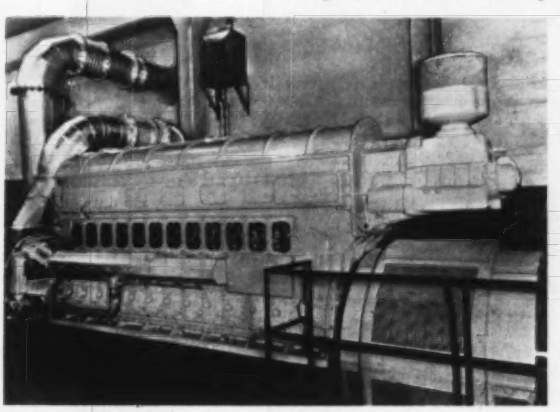
The Accumite system can handle a wide range of lubricants of the lighter grades and will handle many applications where experience has shown that frequent applications of lighter lubricants will replace infrequent applications of heavy greases.

The system offers four different types of lubricant pumps to pressurize the system lines and actuate the measuring valves. The various types deliver enough lubricant to serve from 40 to 200 bearings in one stroke.

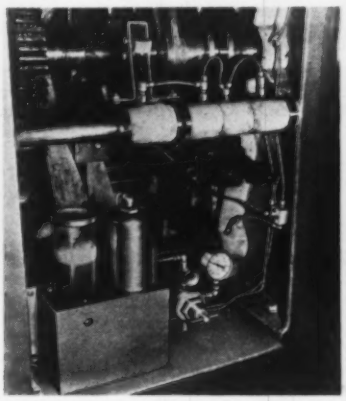
Accumite valve, available in three delivery capacities —0.003, 0.006, and 0.009 cu in.—are designed to meet every installation and bearing requirement.

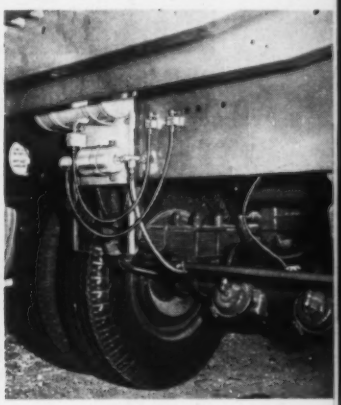
The basic types fit standard threaded bearing ports; "snap-on" types attach directly to threaded and drive fittings, and the "insert" type operates remotely from manifold blocks with tail tubes to bearing inlets.

Accumite systems can have fully automatic actuation by a power-driven pump, automatic control by a time-clock-solenoid mechanism; semiautomatic actuation by a power-driven pump manually controlled by a "push-pull" valve at the operator's discretion, or manual operation by a machine-mounted or portable hand-operated pump.



Turbocharging added 50 per cent to the capacity of this 2-cycle opposed-piston diesel, making it the smallest and lightest commercial diesel in its horsepower range—up to 3600 hp





Alemite Accumite system lubricates 24 points on the efficient spring-winding machine, *left*. Each of 46-tractor-trailer chassis points is automatically lubricated while vehicle operates, *right*.

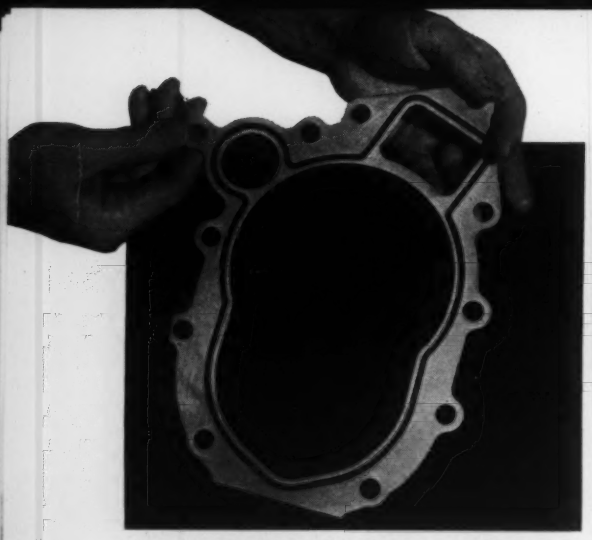
Turbosupercharged Diesel

A TURBOSUPERCHARGED opposed-piston diesel engine, smallest and lightest commercial diesel in its horsepower range, has been announced by Fairbanks, Morse & Company. Supercharging has added 50 per cent to the capacity of this rugged 2-cycle diesel, making it available in ratings up to 3600 hp. An added dividend is a 5 to 10 per cent saving in fuel consumption.

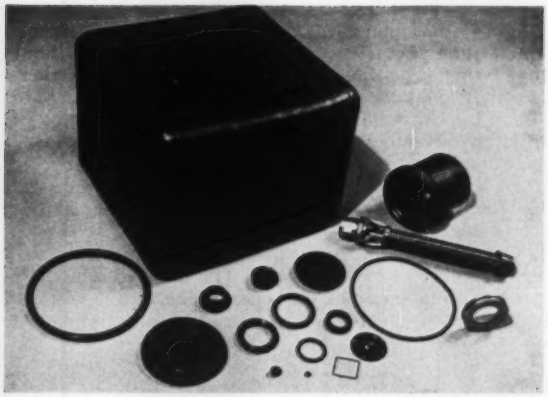
With important advantages in weight, dimensions, first cost, and operating costs, the engine is expected by Fairbanks-Morse engineers to see wide application in stationary power plants, commercial marine installations, locomotives, and mobile power plants.

Turbocharging is available in the 6-cyl and 12-cyl configurations of the $8^1/_8 \times 10$-in. opposed-piston engine. The weight of the 6-cyl basic engine is approximately 24,900 lb, only 2000 lb more than the nonsupercharged engine. Weight of the 12-cyl unit is about 46,200 lb, 4000 lb more than a similar nonsupercharged engine.

At its top rating of 3600 hp at 900 rpm, the 12-cyl diesel weighs only 12.8 lb per hp. Recommended speeds will vary, of course, with the application. It is expected that most stationary power-plant installations will operate at 720 or 750 rpm, marine and locomotive applications at 850 rpm, and stand-by units at 900 rpm. A 12-cyl test engine has been operating steadily in an industrial power plant at 900 rpm, carrying overloads up to 10 per cent.



Molded-in-place gaskets which are resistant to oils, fuels, and solvents at high temperatures can be made of Viton synthetic rubber



Chemical and thermal stability particularly suit Viton to sealing applications and for use in flexible fuel tanks and connecting lines for oils, fuels, and solvents

High-Temperature Elastomer

"VITON," a special-purpose fluorine-containing elastomer with unequaled resistance to oils, fuels, and solvents above 400 F, has demonstrated such superior qualities that E. I. du Pont de Nemours and Company, Inc., has stepped into the production stage with only one year of end-product testing.

Viton is a linear copolymer of vinylidene fluoride and hexafluoropropylene that contains about 65 per cent fluorine by weight.

The remarkable chemical and thermal stability particularly suits the material to sealing applications. Seals of all kinds can be shaped by molding, extrusion, molding in place, or die forming without resort to special procedures. It can also be used as a standard coating for aircraft bladder-type fuel containers, protective clothing, equipment linings, and diaphragms. Other probable uses are for caulks and coatings, pump liners, and aircraft firewalls and vapor walls.

As supplied to rubber-products manufacturers, Viton is a white translucent rubbery product. Viscosity and plasticity are in the same range as present commercial elastomers, and compounds of Viton are easily processed using standard rubber-processing equipment.

A typical Viton compound would contain a curing agent, a filler, and an acid acceptor. When cured, the compounds have such properties as the following:

	At 77 F	At 300 F
Tensile strength, psi	2000–3000	1000
Elongation, per cent	150–350	100
Hardness, Shore A	60–95	..
Resilience, per cent	40–60	70
Compression set (70 hr 250 F) (25 per cent deflection)	10–30	..

Viton stocks have outstanding heat resistance. Estimated service life at several temperatures, as based on the aging time required to produce brittleness, is shown below. Tensile strength is largely unaffected during heat aging, and brittleness and loss in elongation are the eventual causes of failure.

The hours to brittleness are: 2400+ at 400 F, 2000 at 450 F, 300 at 500 F, 100 at 550 F, and 24 at 600 F.

Vulcanizates of Viton are resistant to a wide variety of fluids such as aliphatic, aromatic, or chlorinated hydrocarbons, aromatic amines, diluted and concentrated mineral acids, and alkalies. The effect of a few of these fluids on Viton is as follows:

	Volume increase after 7-day immersion, per cent	Temperature, deg F
JP-4 jet fuel	1	75
ASTM ref. fuel B (aromatic-aliphatic hydrocarbon blend)	3	75
ASTM #3 oil (naphthenic base oil)	3	300
OS-45 hydraulic oil (silicate ester)	10	400
Turbo oil #15 (hydrocarbon oil)	20	400
Dioctyl sebacate	21	300
Water	3	212
Benzene	20	75
Trichlorethylene	10	75

In addition to excellent heat and fluid resistance, Viton synthetic rubber has a high degree of resistance to oxygen, ozone, and weathering.

Balancing Electric-System Load

A COMPUTER will measure the moment-to-moment use of electricity by the 1,940,000 customers in the Chicago area—and simultaneously regulate the output of dozens of generators to meet the exact demand—on the Commonwealth Edison Company system.

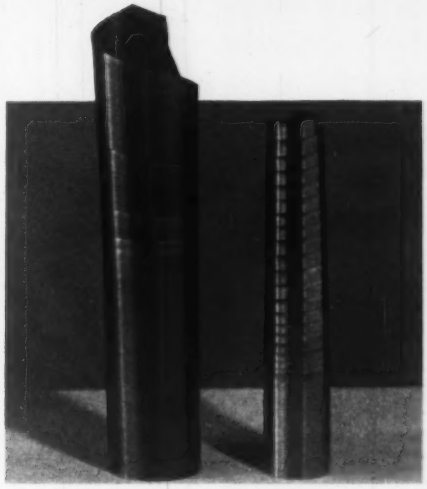
General Electric will manufacture the principal components of the installation, and approximately two years will be required to complete the project.

The installation will be among the first in the country combining the complete computer and generation-control elements.

The device will economically distribute production among the 12 Edison generating stations whose 55 turbine-generating units turned out nearly 20 billion kwhr of electricity last year.

It will not only determine which generators can produce most cheaply, but will also step up or lower the output of the individual machines by remote control.

One of many developments seen by scientists and engineers visiting Russia was this experimental rolling mill in the Ural Branch, Academy of Science, Sverdlovsk



Samples of titanium-alloy foil of 0.005-in. thickness made by powder-metallurgy techniques in the USSR

Powder Metallurgy

POWDER-METALLURGY research on the processes of compaction and consolidation, encompassing such approaches as powder roll bonding and high-temperature pressure sintering, is in progress in Russia.

Details are given in an article in the March *Journal of Metals* on "Powder Metallurgy in the USSR," by Claus G. Goetzal, senior research scientist, Department of Metallurgy, New York University. The article is based on a recent visit resulting from the 1957 New York University-Moscow Steel Institute exchange arrangements.

Titanium

One of the most interesting developments to the author was the result of a 5-year 30-man effort on titanium powder metallurgy at the Central Scientific Research Institute. Products shown included large sheets, thin foil, pierced tubing, thin wire, and compressor or turbine blades. The sheets were over 3 ft wide, 6 ft long, and 0.120 in. thick. The foil had a thickness of less than 0.005 in. and was rolled on a Sendzimir-type mill. The tubing was about $1^1/_2$ in. OD, 1 in. ID, and 12 ft long. The wire was of filament size, less than 0.005 in. in diam. The blades were relatively large and displayed flash from the incompletely closed forging dies.

Some of these products were made from the metal powder, but most from alloy powder. A co-reduction of the mixed oxides was the preferred production method. Processing of the powder included hydrostatic pressing, high-temperature vacuum sintering, and hot-die forging. Hot and cold rolling followed in the case of the sheet and foil, and diamond-die drawing in the case of the fine wire. Hydrostatic ingots were about 15 in. long, 6 in. in diam. It appeared that hot pressing of titanium powder was not used.

The mechanical properties of forged titanium ingots were given as 92,000 psi tensile strength, 30 per cent elongation, 25 per cent reduction of area, 180 Brinell hardness. A typical alloy product in the forged condition had a tensile strength of 142,000 psi, an elongation of 15 to 20 per cent, a reduction of area of 10 to 15 per cent, and a hardness of 210 Brinell. Hot rolling of the same alloy to sheet increased the tensile strength to 156,000 psi, the elongation 30 to 40 per cent, and the reduction of area to 20 to 30 per cent. Hardness then dropped to 195 Brinell.

Beryllium Sheet

At the Kalinin Institute, powder metallurgy is held to be the ideal technique to produce beryllium sheet of satisfactory engineering ductility. Although grain orientation and the concomitant embrittlement in the transverse and especially perpendicular directions to that of rolling are unavoidable, these effects may be considerably reduced, due to a very fine initial grain size and careful manipulation. This was evidenced by some rather flexible strip shown.

The process consists essentially of magnesium reduction of the fluoride, machining and ball milling under argon of the granules to a 325 mesh powder, hydrostatic pressing, vacuum sintering, and hot rolling. Hot pressing apparently is not in use at present.

Ductile Tungsten

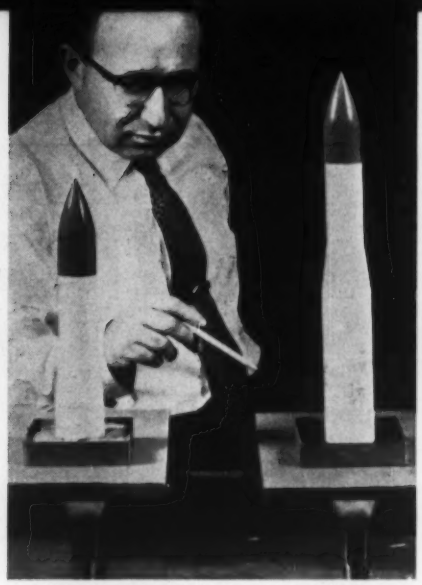
Powder-metallurgy work was demonstrated in several other areas. Apparently considerable effort is expended in some of the refractory metals and their alloys. An alloy of tungsten with 20 per cent rhenium produced at Baikov is but one example. The alloy was demonstrated to have very good room-temperature ductility. It appears that some work is also going on with dispersion strengthening of refractory metal alloys as well as alloys based on the transition elements. Here, however, little concrete evidence of interesting test results was shown.

Considerable advance was shown in the direct rolling of stainless-steel powder at Baikov. An up-to-date powder-rolling facility was demonstrated to produce porous as well as dense strip which displayed excellent ductility after sintering.

In summary, the author states, "Research and development in powder metallurgy in the USSR seem both advanced and intense, but no really spectacular results were noticed, with the possible exception of the titanium, beryllium, and ductile tungsten products. However, further progress in these areas by the Soviets can be expected and bears careful watching."

Other articles on Russian metal processing and research also appear in the March issue of the *Journal of Metals*.

Helium storage bottles are the first large-scale use of lightweight titanium in the ICBM program. They help control propellant flow into combustion chambers.



Comparative insulating effectiveness of Min-K and conventional fibrous insulation with two missile models subjected to same amount of heat. Min-K model, *right*, does not melt at all.

Missile Miscellany

▶ Titanium for −300 F

THE first large-scale use of lightweight titanium in the ICBM program is a 6 per cent Al, 4 per cent V, titanium alloy produced by Titanium Metals Corporation of America for helium storage bottles. These help control propellant flow into combustion chambers of the 5500-mile Atlas. Comparison of weight showed 50 lb for a titanium bottle, 80 lb for aluminum, and 125 lb for steel. These weight savings could add as much as 700 miles to the range.

The corrosion-resistant bottles, which are basically two hemispheres welded together in an inert atmosphere, must withstand internal pressures of 5000 lb. The helium is stored at about −300 F.

▶ Stainless Steel Nose Cone of Explorer

The nose cone of the Explorer was made of stainless steel which was selected because of its high corrosion resistance, tensile strength, and resistance to temperature extremes, even when used in thin gages for lightness. Type-340 stainless, the same grade used for automobile trim, was used in cold-forming by the Floturn process at The Lodge & Shipley Company plant in Cincinnati, Ohio. The cone is 12 in. long and 6 in. wide at its maximum with a wall-thickness range from conical walls of 0.013/0.017 in. to 0.094 in. at the middle of the blunt nose. Weight before assembly was only 13 oz.

The Floturn method is basically a cold-rolling process in which the displacement of metal is parallel to the center line of the part being formed. Metallurgical effects are similar to cold rolling. Granular structure is compressed and refined; yet flow lines are unbroken, adding considerable strength and hardness. Internal stresses are minimized and are virtually uniform with no potential or actual points of metal failure produced in the process. The stresses that are produced can be completely relieved by standard annealing treatment.

Further details of the process are given in C. L. Sporck and W. H. Busch, "Floturn—A Production Process as Well as a Development," ASME Paper No. 57—SA-98.

▶ High-Temperature Insulating Material

Min-K, an entirely new type of thermal-insulating material with excellent strength, hardenability, and resistance to vibration developed by the Johns-Manville Research Center, Manville, N. J., has less than half the thermal conductivity of conventional insulations and can be formed to comparatively close dimensional tolerances. It is especially suited for space-saving applications in the guided-missile and aircraft industry.

The insulation has a bonded structure reinforced with fibrous media and contains appreciable quantities of exceedingly small particulate matter. This creates pores so minute that a large proportion of the gas molecules collide with the walls of the structure rather than with other molecules. Thus the amount of heat transferred by molecular conduction is considerably reduced below that which would occur in a still air space, previously considered the theoretical boundary for insulating materials.

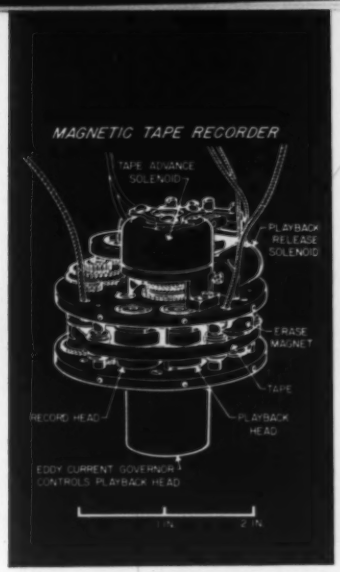
Opacifying media which effectively minimize the transmission of radiant energy through the insulation are also incorporated in Min-K. The thermal conductivity of Min-K decreases appreciably at lowered atmospheric pressure, and consequently at higher altitudes—as much as 50 per cent at 10 miles.

Min-K designates a family of products ranging from the 500 series for lower-temperature applications to the 1300 series for extended periods of high-temperature service up to 1300 F.

▶ Explorer 3's Tape Recorder

An ingenious miniature tape recorder—the size of a king-size cigarette package—gives the third U. S. IGY earth satellite launched by the Army, Explorer 3, the ability to provide five times the information on cosmic-ray intensities that was furnished by Explorer 1. It will also prolong the life of the high-power transmitter from 2 weeks to 2 months, since the transmitter will only be on the air during the time it is relaying information to the ground.

Ultrasonic testing of Explorer's stainless-steel nose cone is made with an ultrasonic resonance gage. Vidigage is used for final testing of nose cone's wall thickness, indicated directly by the trace on the cathode-ray tube.



Magnetic-tape recorder in the third Army satellite reports total omnidirectional cosmic-ray information when interrogated, wipes, and starts again

Explorer 1 sampled three items of information—cosmic rays, micrometeorites, and temperature levels. Explorer 3, launched on January 31, will also receive total omnidirectional cosmic-ray incidences and intensities throughout the satellite orbit.

As the satellite swings over the Minitrack ground network along the 75th meridian in North and South America it will be interrogated by a radio command signal from the ground which will tell it to report what it has found. In approximately 5 sec, the playback head of the miniature recorder will cascade back a veritable torrent of information that was picked up on its 55 in. of magnetic tape during the 2 hr or more of its flight.

After it is interrogated the tape is erased and the recorder resets itself by a system of cams and electric solenoids to collect new information.

After reception of this rapid-fire signal on the ground, it will be passed through special filters to reduce the background noise. Then it will be translated in the form of visual lines on an oscilloscope to sort out the information in its code.

The recorder was designed by James A. Van Allen, head of the physics department at the State University of Iowa, and originally proposed for Explorer 1. It was slightly modified by the California Institute of Technology's Jet Propulsion Laboratory which joined the Army Ballistic Missile Agency, Huntsville, Ala., in launching the satellite.

Other than the difference in the life expectancy for the high-power transmitter, there was little difference between Explorers 1 and 3, except for an additional 0.2 lb of instrumentation for a total weight of 31.00 lb.

Nuclear Briefs

▶ High-Flux Research Reactor

THE Oak Ridge Research Reactor, ORR, a heterogeneous demineralized-water moderated and cooled reactor went critical in March. The ORR is designed to operate at a power level of 20,000 to 30,000 kw of heat with an average thermal neutron flux greater than 1×10^{14} neutrons per sq cm per sec. It has a beryllium-reflected core which utilizes enriched-uranium plate-type elements of uranium-aluminum alloy clad with aluminum. A modification of the Materials Testing Reactor, the ORR will be used for fundamental research and engineering studies on the effect of nuclear radiation on reactor materials, particularly fuel elements and structural materials in the high-flux region.

The reactor core is housed in a 15-ft-high 5-ft-diam tank which is submerged in a 21-ft-long 10-ft-wide 28-ft-deep pool. Entire fuel systems rather than single samples can be brought into the high-flux region through penetrations in the concrete walls at one end and side, as well as from the top of the reactor and the adjacent pool.

With the start-up of the ORR, Oak Ridge National Laboratory now has six nuclear reactors in operation. The others are the Bulk Shielding Facility, the Low Intensity Test Reactor, the Tower Shielding Facility, the Homogeneous Reactor Experiment No. 2, and the Oak Ridge Graphite Reactor.

▶ Fusion in Japan

A thermonuclear reaction similar to those announced by the United States and Great Britain (MECHANICAL ENGINEERING, March, 1958, pp. 93–94) is reported from Japan. Using a discharge chamber operated at 85,000 volts and about 1.1 million amp, physicists of Osaka University obtained what is believed to have been a fusion reaction. Temperatures of 1 million C occurred for a millionth of a second. The heat may have been double that amount, with a potential for the apparatus of 5 million C.

According to *Science*, March 21, 1958, the Atomic Energy Committee of the Japan Academy of Sciences stated that the apparatus used was "much smaller than the British Zeta and cost about one tenth as much." The Japanese reaction is estimated to have produced 5 million neutrons per pulse, compared with the 3 million produced in the British experiment.

1 Protecting Salt. Tarpaulins of Fiberthin, an extremely tough neoprene-coated nylon fabric made by the Dominion Rubber Company, Ltd. (United States Rubber Company), protect this 10,000-ton pile of salt used for icy winter highways near Montreal, Que., Canada. The lightweight panels can be handled by one man and are added or removed as the pile contracts or expands.

2 Remote Look. One of the largest closed-circuit-TV systems ever installed, consisting of 36 complete camera-receiver chains, monitors hazardous static rocket firings in the liquid and solid-propellant rocket plants at Aerojet-General Corporation's rocket-engine test facility in Sacramento, Calif. All-electrical camera controls for the $300,000 system built by The Siegler Corporation's Hallamore Electronics Company division, Anaheim, Calif., are at the viewing site.

3 Shadowless Light. A luminous parabolic curved ceiling designed and manufactured by the Wakefield Company, of Vermilion, Ohio, extends from floor to floor in Chrysler Corporation's styling showroom, Highland Park, Mich. The translucent Bakelite rigid vinyl sheets are color-stable and diffuse light without glare or shadows to provide a simulated horizon for checking automobile silhouettes and 240-ft candles at working level.

4 Tough Tires. B. F. Goodrich tubeless tires have made as many as six set-downs at landing speeds in excess of 250 mph. The jet-powered nuclear-warhead-carrying Regulus II, made by Chance Vought for launching from submarines and surface ships, has two 9000-lb static-weight supporting tires on the main gear and a 2000-lb nose-wheel tire.

5 Tire-Cord Machine. The 48-spindle production machine invented by R. J. Clarkson, shown in photo, forms and winds rayon tire cord for United States Rubber Company in a single operation where three separate machines used to be required. It will save 54 per cent in floor space, require 62 per cent less manpower, cut the number of knots in tire cord by 75 per cent, reduce waste by 77 per cent, and reduce investment for added capacity by 44 per cent for tire cord—the country's largest single use of textiles.

6 Colder Than Antarctica. Clamps are adjusted on a Fiberglas radome at 65 below zero F in the environmental test chamber at Westinghouse Electric Company's Friendship Airport plant in Baltimore, Md. Two separate sections of the 10-ft-high, 18-ft-wide, and 16-ft-deep apparatus are heavily insulated and lined with stainless steel. For rapid-temperature-change tests, air can be heated or cooled in an area above the test chamber and introduced suddenly through trap doors in the ceiling.

7 Making Change. William A. Patzer demonstrates his electronic bill changer, the first practical device to accept paper money and make proper change. It will be manufactured by the A.B.T. Manufacturing Corporation, a subsidiary of the Atwood Vacuum Machine Company, Chicago, Ill.

8 Giant Valves. Two of the largest butterfly valves ever used in steel-mill service are being installed by Jones & Laughlin Steel Corporation. The 8-ft 6-in-ID valves fabricated by the Blaw-Knox Company are part of the electrostatic-precipitator circuit of the basic-oxygen-furnace process, and will handle 235,000 cfm of gas at 500 F. The pneumatically controlled units will be water-cooled rather than refractory-lined.

9 Impulse Turbine. The wheel of the first impulse-type turbine ordered by the Bureau of Reclamation nears completion. The 4-jet 23,500-hp impulse turbine will operate at 600 rpm with a head of 1800 ft. The total assembly weighs 6000 lb and the buckets were cast integral with the disk.

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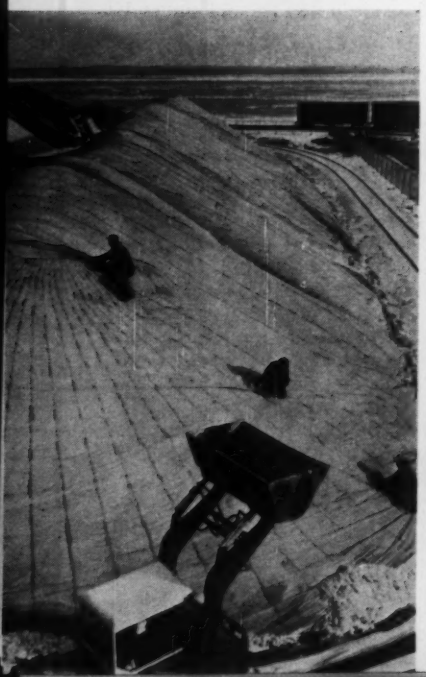

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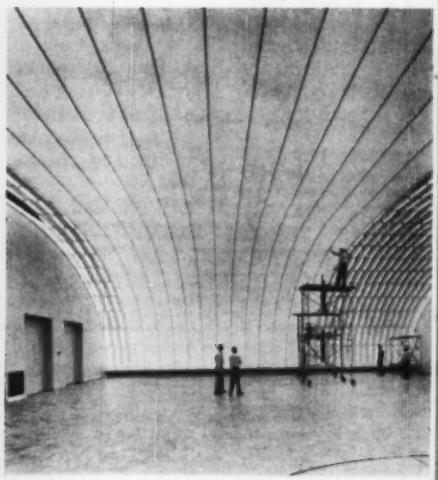

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PHOTO BRIEFS

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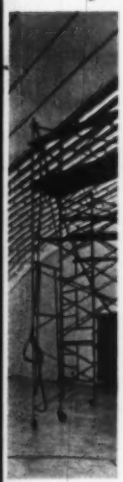

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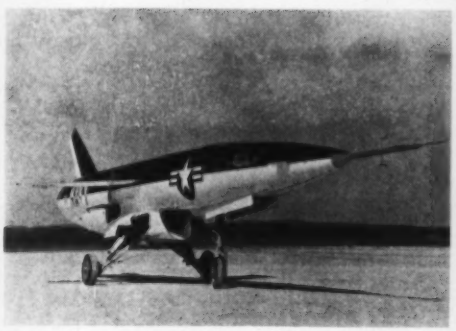

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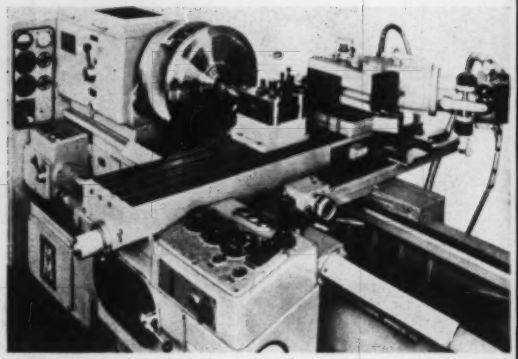
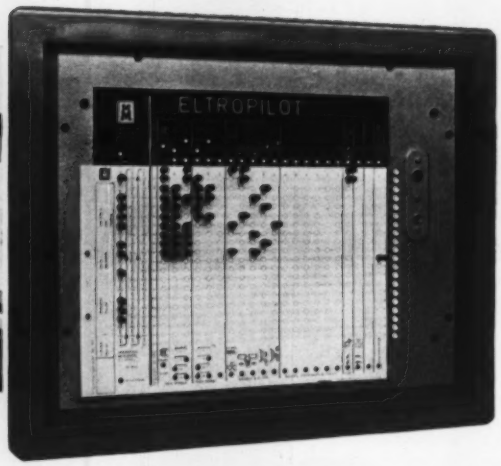
Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European
Correspondent

EUROPEAN SURVEY





Control panel, *right,* of lathe with constant cutting speed for copy-facing, *left,* developed by Max Muller-Brinker Maschinenfabrik, Hanover, Germany

Copy-Facing Lathe

A PRODUCTION lathe for copy-facing at constant cutting speed, controlled from the motion of the tool point, with automatic sequence of operations, has been developed by the Max Müller-Brinker Maschinenfabrik, of Max Müller Strasse 4, Hanover, Germany. Known as the "Eltromatic," Model PFE III, it is claimed to have the most powerful hydraulic copying attachment on the market, capable of absorbing the full power of the main driving motor in its tool pressure cylinder. As the copying movement is superimposed on the travel of the cross slide, a compensating device is fitted to maintain a truly constant cutting speed at the tool point. The desired feed, and rapid travel in any direction, can be switched in at any time, either by hand or automatically by program control from a punched card.

The machine is made in two sizes, respectively $11^{13}/_{16}$ in. and $13^{13}/_{16}$ in. over the bed. There is a $9^{7}/_{8}$-in. gap in front of the faceplate or chuck, giving a maximum swing diam of $37^{3}/_{8}$ in. in the smaller size and $41^{5}/_{16}$ in. in the larger. The distance between centers, according to requirements, may be from 30 in. to 120 in., the corresponding maximum lengths for copy-turning ranging from 14 in. to 103 in.

There are four ranges of spindle speeds for each of two sets of change gears, and within each range the required revolutions can be either set by hand or regulated automatically within a ratio of 1:7, and can be preselected with the machine either standing or running. It can be used not only for the production turning of components involving large variations in diameter, at constant cutting speed, but also for work requiring considerable changes in the depth of cut, at either constant spindle revolutions or constant cutting speed.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

New Large Boiler Unit

IN THE "European Survey" (see August, 1957, issue of MECHANICAL ENGINEERING, p. 767) it was stated that the British Central Electricity Authority was planning to spend the equivalent of about $112 million in building at Thorpe Marsh, Yorkshire, England, a power station containing two generating units, each of 550,000-kw capacity. Steam for each unit will be provided by a single boiler, some further particulars of which are now available. It has been decided by the Central Electricity Generating Board (the newly formed agency which has superseded the former Central Electricity Authority since the beginning of this year) to order the first boiler from International Combustion Ltd.

It will consume between 205 and 220 tons of coal an hour, according to the coal quality, and will be required to deliver to the turbines (of which there will be two, cross-compounded) 3,750,000 lb per hr of steam at 2400 psi and 1055 F. At full load the feedwater will enter the boiler at 2600 psi and 496 F. After passing through the high-pressure turbine, the steam will be returned to the boiler for reheating to the original temperature of 1055 F and passed through the remaining turbine stages.

The boiler will have two furnaces, each subdivided into two sections, fully cooled by water or steam tubes; one furnace controls the main steam temperature and the other the reheat temperature, and each will be 68 ft

wide, 28 ft deep, and 100 ft high. The main drums of the boiler will be 148 ft 6 in. above ground level. The coal will be pulverized in eight mills with a nominal capacity of 50 tons an hour each, but it is expected that three will be enough to carry the full load on each furnace, leaving the fourth free for maintenance. The circulation of the water will be pump-assisted, the motors driving the pumps being water-immersed to avoid the need to bring the spindles out through the pressure casings. The boiler will have four rotary air heaters and four sets of fans. Both mechanical and electrostatic dust-extraction plant will be fitted to clean the chimney gases at a cost of more than 10 per cent of the whole cost of the boiler plant, as all sections of the recent Clean Air Act will be in force when the unit goes into service, and its provisions are extremely stringent. The guaranteed efficiency of the boiler is 90 per cent.

Natural Gas in France

THE unexpected discovery of a large deposit of natural gas in the valley of the Gave de Pau, in southwest France, rather more than six years ago, presented the Société Nationale des Pétroles d'Aquitaine (who had been prospecting for oil) with some serious problems—for the gas erupted with great violence, blowing the drill rods out of the bore, and it proved to be dangerously toxic and highly corrosive. Before it could be used, therefore, a plant had to be provided to remove the acid constituents and the sulfur from the hydrogen sulfide which it was found to contain, and also to extract, as valuable by-products, propane, butane, and gasoline.

To carry out all these processes it was necessary to erect a desulfurization plant of somewhat unusual design, so far as French experience went; and this plant, constructed with the help of American experts, but incorporating caustic-soda scrubbing to comply with the requirements of the French Government, went into service about a year ago.

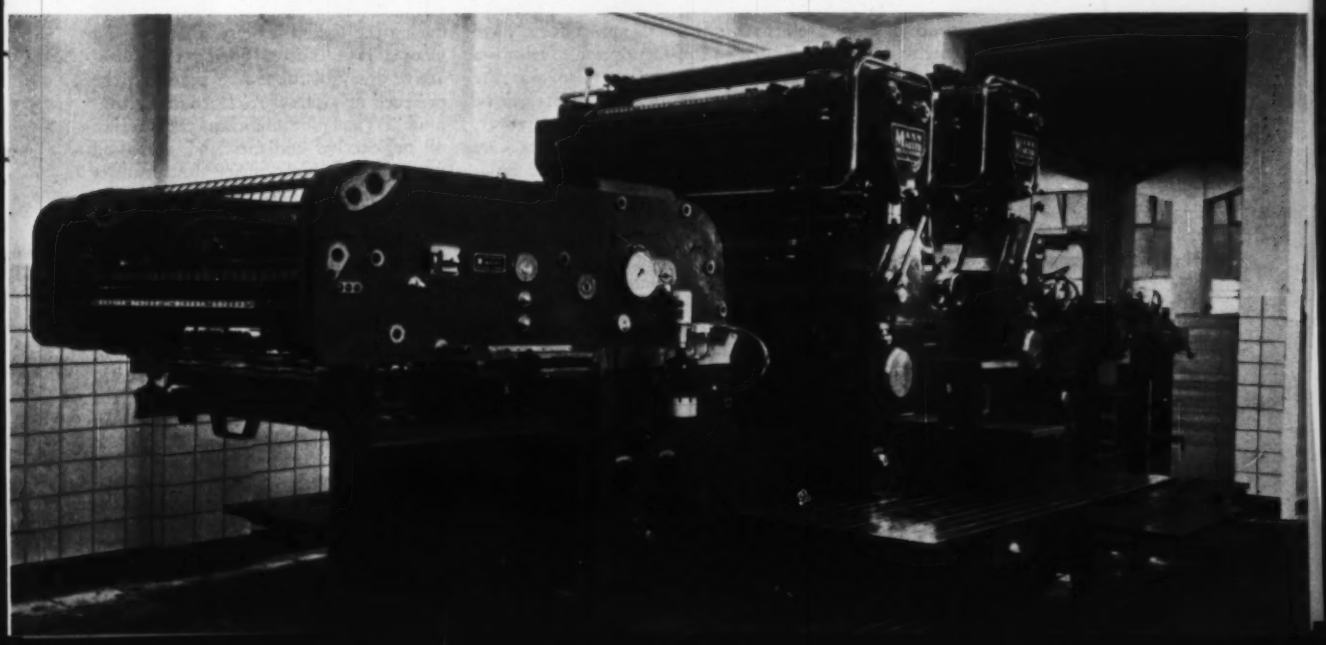
According to a paper recently read in London at a joint meeting of the Institute of Fuel and the Société des Ingénieurs Civils de France, by M. André Blanchard, president of the Société Nationale des Pétroles d'Aquitaine, it is now operating satisfactorily after various initial teething troubles. It is capable of handling a million cu m of gas per day and of producing about 70,000 tons of sulfur a year—a quarter of France's present consumption; but the eventual aim is to produce 1,300,000 tons a year, which will make France the third largest sulfur producer in the world.

Work has begun on a system of pipelines which is expected to extend over most of central and southern France; at first to Bayonne, Pau, and the valley of the Garonne, then to the Nantes area and to the industrial districts of Lyons, St Etienne, Saône-et-Loire, and perhaps Isère, and in due course probably to Paris. The output of crude gas is expected to reach 20 million cu m per day, the fuel equivalent of 4 million tons of oil or 6 million tons of coal per annum.

Litho Printing Press

WHAT is claimed to be the fastest two-color offset litho printing press yet constructed is now in production by the London, England, firm of George Mann & Company, Ltd. The machine, one of which has been installed in the works of van der Poll Suykerbuyk at Rosendaal, Holland, has a maximum sheet size of 38 in. by $25^1/_2$ in. and prints at the speed of 7500 impressions per hr. Sheets are fed in stream formation down the lay-board, the leading edge of each sheet passing under smoothers attached to primary front lays which guide the sheet forward, correcting any errors in alignment and slowing down the sheet so that it is not buckled or bruised on impact when it reaches the main front lay. The slowdown lays are lifted on their return stroke. Automatic check fingers trip the press if a sheet is late.

The swing arm which transfers the sheet to the first of the two feed cylinders is positively cam-operated in both directions of swing. A handwheel adjusts the height of the feed plate for variations in stock thickness; another handwheel adjusts the printing pressure, and there is a microadjustment for blanket-to-plate pressure, should the blanket swell during running. The ink-knife can be retracted for cleaning and returned to its operating position without disturbing the original setting. The suction roller is fitted with an air blast which can be turned on when it is not printing, to remove dust and fluff. The main cylinder bearings and the more important shafts are lubricated automatically by a high-pressure meter valve system. Secondary lubrication is by a hand-operated pump.



Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Nuclear Engineering

Steady-State Thermal Design of Pressurized, Light-Water Cooled and Moderated Nuclear Reactor Cores.....57—A-219

By J. H. Helve, Assoc. Mem. ASME, Knolls Atomic Power Laboratory, General Electric Company, Schenectady, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

A comprehensive method of analysis employed in practical steady-state thermal design of pressurized light-water cooled nuclear reactors is presented. This involves determining the operating metal and coolant temperatures for a given fuel-element design and operating conditions. Core design, its philosophy, and the unsolved problems are discussed. Detailed discussion is given to the problems, design data, and factors with which the core designer must become familiar. A step-by-step calculation procedure is presented which is applicable to any liquid-cooled reactor. The effect of boiling on the fuel elements is included.

The present practice in steady-state thermal analysis of the reactor core is given. Future designs will be based primarily on transient performance during a casualty as additional experience is gained with the phenomenon of burnout. This is not a departure from present practice but it is a change in sequence of design analysis. The core designer will determine what power distribution is safe for a specified steady-state power output at the beginning of the most probable transient and ask the physicist to produce a nuclear design meeting the requirements. In other words, future core designs will be based on the ability of the fuel elements to withstand burnout under all expected operating conditions and the design yardstick will be the minimum expected burnout ratio.

With more test data, actual reactor operating experience, and better understanding of the various mechanisms of heat transfer, the core designer will be able to predict the performance of power reactors with greater confidence.

Component Optimization for Nuclear-Powered Closed-Cycle Gas-Turbine Power Plants..57—A-259

By H. A. Ohlgren, Mem. ASME, and F. G. Hammitt, University of Michigan, Ann Arbor, Mich. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Some of the advantages of a closed-cycle gas-turbine design are:

1 Increased capacity for a given size and/or weight.

2 Wider range of loads without substantial loss of efficiency, since power may be reduced by reducing pressure level without affecting temperature, pressure ratios, or speed.

3 Reduction of size tends to control difficulties resulting from differential temperature extraction.

4 In nuclear-powered, closed-cycle gas turbine systems, it is possible to contain the working fluid in a closed system so that direct extraction of heat from the reactor into a working fluid can be achieved without release of radioactive gas to the atmosphere.

Summaries are given of results and calculations of a nuclear-powered gas-turbine system which employs a reactor which is internally cooled in core and reflector by the working fluid which is used directly in a regenerative closed-cycle gas-turbine system. Efforts have been made to consider optimum selection of the various components so that the integrated system of components can be evaluated in terms of reactor heat power, maximum temperature in reactor core and reflector, choice of working fluid, selection of pressure ratio, and maximum working-fluid pressure.

In order to illustrate the techniques employed for optimization of these parameters for a reactor coupled with a closed-cycle gas turbine, the authors have selected a reactor heat-power output in the range of 5–10 megawatts from which it appears that the economically optimized electrical power outputs are in the range of 1400–2800 kilowatts.

Although several possible types of molten reactor fuels can be employed in reactor designs, it appears that there are immediate possibilities for U-235 or plutonium dissolved in bismuth metal, and operated at high temperatures. Such a concept is being considered by the Brookhaven National Laboratories.

From those data which have been made available to the authors, programs and projects have been conducted to project these data to a practical, small-scale "burner" nuclear power plant, the success of which is contingent upon a vast amount of additional research, development, and engineering. The results of the analyses do indicate that this type of reactor with built-in heat transfer surfaces has a potential for application in the lower reactor heat power range where light weight and high efficiencies in the consumption of nuclear fuels are extremely important.

Safety Features of Nuclear-Power Reactors.....57—A-265

By Stuart McLain, Downers Grove, Ill.; and R. O. Brittan, Argonne National Laboratory, Lemont, Ill. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The special hazards of nuclear-reactor operation result from the possible effects of the neutrons and gamma rays emitted during the fission process, the beta and gamma rays emitted during the radioactive decay of the fission products, the presence of alpha-particle emitting uranium-233 and plutonium, and the presence of radioactive coolants and corrosion products in the primary heat-transfer loops. In addition, the reactors have the normal industrial hazards associated with the stored and potential chemical energy of high-temperature water systems and chemically active liquid-sodium systems or other coolants.

The mechanism of nuclear-reactor accidents is discussed, and questions of safety and maintenance are considered in detail. In addition, a number of inherent safety mechanisms which are present in nuclear reactors are considered. These

factors may enhance, inhibit, or completely arrest unplanned power transients. It is the combination of these inherent safety mechanisms with the automatic control mechanisms and responsible management which determines the safety of reactors.

Accidental transients, reactor-control systems, operating problems, and management's responsibilities for reactor safety are also given detailed treatment.

This paper is a revised version of a paper presented originally at the 1955 Nuclear Engineering and Science Congress held in Cleveland, Ohio. The original paper was published in *Problems in Nuclear Engineering*, Vol. 1, edited by D. J. Hughes, Stuart McLain, and Clark Williams, Pergamon Press (1957).

Air-Operated Reactor Safety Rods .....57—A-233

By G. E. Wade, Assoc. Mem. ASME, General Electric Co., Richland, Wash. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Nuclear reactors are used today for purposes ranging from research and medicine through ship propulsion and power production. During operation the reactors are continuously monitored by a large and varied array of instruments. When these instruments sense an operating condition that is beyond set limits the reactor is shut down or "scrammed" to prevent damage.

The required operating characteristics of a reactor safety rod for a graphite-moderated reactor are reviewed. An air-operated safety-rod drive mechanism meeting these requirements is presented.

The air-operated safety rod is nothing more than a large air cylinder mounted on top of the reactor. The piston rod serves as the reactor safety rod. When the rod is in the reactor, air can be admitted below the piston and the rod removed from the reactor. Near the end of this upward stroke the rod is decelerated with an adjustable air cushion. An accumulator attached directly to the top of the cylinder contains a supply of air sufficient to accelerate the rod into the reactor. By sizing this accumulator and controlling the pressure, the accelerating force can be adjusted to attain full rod travel in 0.5 sec. Another adjustable air cushion is used to decelerate the rod near the end of its stroke after a scram.

The sizing of drive components, based on an analytical determination of the time-displacement relations for the mechanism, is discussed. This method of size determination has been verified by tests on an experimental model. These tests also provide information on the adjustment of the mechanism.

Why Low-Pressure Steam From Nuclear Reactors?.....57—A-234

By P. R. Kasten and M. W. Rosenthal, Oak Ridge National Laboratory, Oak Ridge, Tenn. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

It is perhaps disappointing to designers of conventional power systems to learn that nuclear reactors—the promised power source of the future—are in many cases producers of low-pressure steam. In fact, the steam generated by most nuclear-power reactors built to date is of relatively low temperature and pressure. Whether in the long run it will be more advantageous to generate high-pressure or low-pressure steam will depend upon the associated investment and fuel costs for the particular systems. In conventional power plants of today, it is more economical to build high-pressure units, since this leads to greater thermal efficiencies and thus lower fuel costs than would be obtained in units operating at lower temperatures and pressures. This effect is obtained, at least in part, because the fuel-feed cost per unit energy generated in the boiler is virtually independent of the steam temperature produced. That this also will be true for nuclear power stations has not been shown as yet.

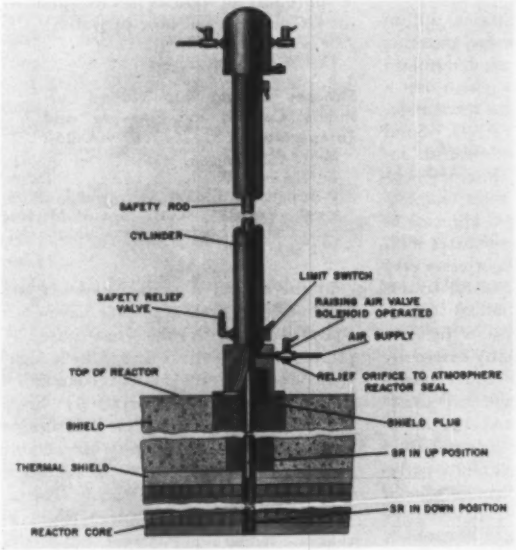
Examination of a number of reactor concepts—pressurized-water, gas-cooled, liquid-metal cooled, and nonaqueous liquid-fueled reactors—reveals that there are some economic disadvantages associated with the production of high-temperature steam which tend to offset the advantage of high thermal efficiency. Depending on the specific system, these are variously associated with poor fuel regeneration, large fuel inventory, and high auxiliary-power requirements. As a consequence, in contrast to fossil-fuel plants, nuclear power systems having low thermal efficiencies may have lower fuel costs than those having high efficiencies.

An Analytic Method of Predicting Temperature Gradients in Thick-Walled Pressure Vessels.....57—A-231

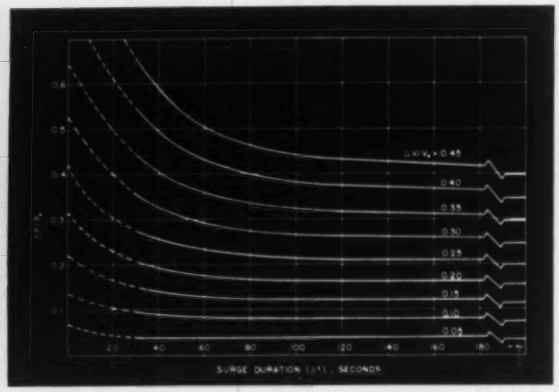
By J. S. Hucks, Assoc. Mem. ASME, and A. L. Gaines, Mem. ASME, Combustion Engineering, Inc., Chattanooga, Tenn. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

In order to insure the structural integrity of extremely large, thick-walled pressure vessels, such as are encountered in the design of pressurized-water reactor systems, the pressure-vessel design must be adequate to withstand internal pressure, external loadings, and the temperature variations due to system operational demands. The internal pressure may be controlled during operation of the system; the external loadings due to causes other than thermal are well defined; however, the temperature variations within the materials are neither controllable nor well defined. The effect of thermal discontinuities must be included as stress components in the structural analysis. These effects are determined from the history of temperature-time-position relations which can be obtained from the solution of basic heat-transfer equations wherein the boundary conditions are extremely difficult to incorporate in the solutions.

Analytical methods for determining the thermal gradients in a thick-walled pres-



Reactor safety rod. General view of safety-rod system including the cylinder, accumulator, the channel in the graphite in which the rod operates, and other major drive components (57—A-233)



Overpressure prediction curves for positive sinusoidal surges in a vertical cylindrical surge tank of length/diameter ratio about 4 (57—A-269)

sure vessel due to a linear temperature change on the inner surface were determined and found to be verified experimentally. The analytical method was found to predict accurately the thermal gradients in uniform sections; and an empirical relation, the gradients at a discontinuity of sections. A discussion is included on the methods, boundary-condition assumptions, and physical constants, as used in the analytical approach to the transient-conduction heat-flow problem.

The Dependence of Thermal Stresses in Cylindrical Reactor Fuel Elements Upon the Method of Cooling . . . . . 57—A-136

By K. R. Merckx, Assoc. Mem. ASME, Hanford Laboratories Operation, General Electric Company, Richland, Wash. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Thermal stresses and strains within cylindrical uranium-reactor fuel elements cooled by various methods are determined with a method of analysis which uses a material model relating the strain rate, temperature, strain, and stress. Solid and hollow cylindrical fuel elements internally, externally, and internally-externally cooled, operating in the temperature ranges of 200 to 600 C are used as numerical examples. For the cases with equal temperature drops, the stresses vary by 8 per cent, while the plastic strains vary 140 per cent. The thermal stresses and strains in solid and hollow fuel elements externally and internally-externally cooled are compared for equal power generations. The maximum stress may be reduced 35 per cent and the maximum plastic strain 75 per cent if a solid fuel element is replaced by an internally-externally cooled fuel element (inner radius/outer radius = 0.4) producing the same power per foot.

A Fundamental Approach to the Analysis of Steam Surge Tank Transients . . . . . 57—A-269

By D. B. Bosley, Lieutenant, USN; R. S. Leddick, Lieutenant, USN; and E. E. Drucker, Syracuse University, Syracuse, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Within the limitations of the available data and the stability of the analog computer, the thermodynamic behavior of a surge-tank steam mass has been simulated closely. It has been shown that design on the basis of isentropic compression is extremely conservative. Much more realistic overpressures can be predicted from the analysis presented. In addition, a good understanding of the thermodynamic processes involved has resulted. The inherent flexibility of the analog computer makes it ideally suited for the simulation of tank behavior for any type of surge and for various modifications to the simple in-or-out-flow of water.

Stresses in Long Thick-Walled Cylinders Caused by Pressure and Temperature . . . . . 57—A-256

By G. Sonnemann, Assoc. Mem. ASME, University of Pittsburgh, and D. M. Davis, Westinghouse Electric Corporation, Pittsburgh, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

In the design of pressure vessels and pipelines two basic problems have been analyzed repeatedly, the stress caused by pressure and the stress caused by a logarithmic temperature gradient (conduction without internal heat generation). Since the introduction of nuclear reactors, a third area has become very important; namely, stress induced by a radiation source inside the pressure vessel. The radiation gives rise to an internal generation rate which is exponential and decays as one moves outward in the radial direction. Though earlier work has considered the problem with internal heat generation by applying a slab temperature solution to the cylindrical stress equations, the accuracy of this solution was undetermined and application is lengthy since curves for the stresses are generally unavailable.

For a long thick-walled cylinder the nondimensional radial, axial, and circumferential stresses have been evaluated for the condition of axial symmetry for the cases of pressure, logarithmic temperature distribution, and internal heat generation due to nuclear radiation. All maximum stresses are presented in graphical form as a function of diameter ratio (y_0) and some additional curves showing the stress distributions are included for completeness. Stresses caused by nuclear radiation were computed for the boundary conditions of: (*a*) equal surface temperatures, (*b*) inner wall adiabatic, (*c*) outer wall adiabatic, and (*d*) equal coolant bulk temperatures in both annuli.

Vibration of Rods Induced by Water in Parallel Flow . . . . . 57—A-94

By D. Burgreen, Nuclear Development Associates, White Plains, N. Y.; and J. J. Byrnes and S. M. Benforado, Walter Kidde Nuclear Laboratories, Garden City, N. Y. 1957 ASME Annual Meeting Paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

An experimental determination was made of the type and magnitude of vibration in the simulated fuel rods of a heterogeneous nuclear reactor with water flowing parallel to the rod axes. Triangular lattices with equivalent hydraulic diameters of 0.0708, 0.198, and 0.470 ft, were studied at a single rod length. The test rods employed had a range of natural frequencies of vibration in water of 5 to 25 cycles per sec. This range was obtained by using $^1/_2$ and $^5/_8$-in-diam rods made of brass or aluminum, by making some rods hollow and others solid, and by using fixed and pin-ended support conditions. The water velocity was varied from 6 to 21 fps at room temperature. It was found that the vibration can be significant for reactor conditions. The rod vibration was observed to be self-excited, resulting in the rods vibrating at their natural frequencies independent of the water velocity. A theoretical study of the forces acting on the rods was made from which it appears that ten variables (of which six were varied in these tests) influence the amplitude of vibration of the rod. A correlation was derived and the resulting equations give a good fit with the test data.

Solar Energy Applications

Intermittent Absorption Cooling Systems With Solar Regeneration.....57—A-260

By D. A. Williams, Esso Laboratories, Linden, N. J.; R. Chung, University of Wisconsin, Madison, Wis.; G. O. G. Lof and D. A. Fester, Chemical Engineering Consultants, Denver, Col.; and J. A. Duffie, Solar Engineering Laboratory, University of Wisconsin, Madison, Wis. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Use of intermittent adsorption or absorption refrigeration cycles, regenerated by heating with solar energy, has been proposed as a method for providing small food coolers and space cooling. These coolers would probably have their principal application in nonindustrialized areas where refrigeration is not otherwise available for economic or technological reasons, and where solar radiation is ample and reasonably dependable.

A study of these food coolers has yielded performance data, some of which are reported in this paper. The objectives of the paper are: (*a*) To present a method for evaluating potentially useful binary absorption or adsorption systems; (*b*) to show how operating variables affect the ideal thermal performance of four specific systems; (*c*) to present illustrative experimental data on the solar operation of two intermittent refrigeration systems; (*d*) to analyze the experimental results of the solar regeneration process as it affects the refrigeration capacity.

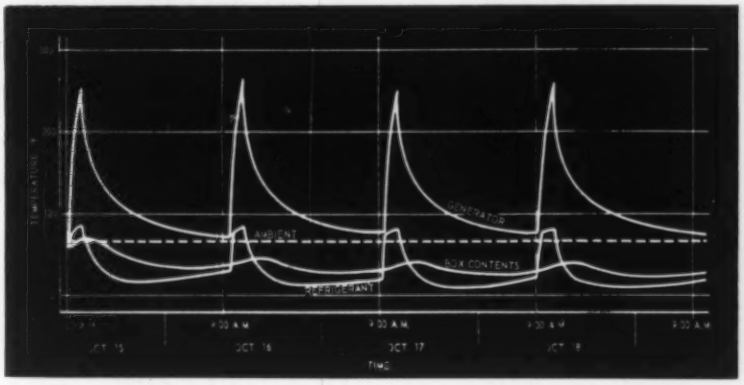
Engineering Research With a Solar Furnace.....57—A-261

By P. E. Glaser, Mem. ASME, Arthur D. Little, Inc., Cambridge, Mass. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Research approaches are discussed for use with a solar furnace regarding the measurement of properties of matter and testing of materials at high temperatures under controlled conditions in the laboratory.

Instruments to measure temperatures, heat flux, and flux density are described, and their uses pointed out. Methods for measuring thermal conductivity, thermal expansion, heat content, and emissivity of material sare explained and the analytical and experimental procedure outlined.

Temperatures of absorber-generator, evaporator-condenser and cooler box contents, and mean ambient temperature for four days' operation of an ammonia-water unit (57—A-260)



Gas Turbine Power

High-Temperature Gas-Cycle Reactor Power Systems...57—A-274

By J. R. Johnson, Minnesota Mining and Manufacturing Company, St. Paul, Minn. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The successful development of economic nuclear electric power is dependent on the choice of the reactor system and the power system coupled with it. Materials of construction are the key to successful nuclear power development, ultimately dictating or modifying the choice of systems. The choice may be made on the basis of other considerations followed by a sea ch for materials which meet the requirements. For example, the reactor system may be chosen so as to minimize fuel costs or reprocessing costs, or another system may be chosen to achieve the maximum power from the smallest possible reactor vessel. It appears fundamental, however, that the power system should be designed to produce the maximum possible thermal efficiency. Present fossil-fueled electric generating stations produce power with plant conversion efficiencies approaching 40 per cent. Whether nuclear electric power is considered as competing with conventional fuel power or as a supplemental energy source, it should be capable of equal or better performance.

Present-day materials technology indicates that the most probable way of achieving high thermal efficiency nuclear power plants is through the use of high-temperature pressurized-gas-power systems. The heated gas in turn may be used to produce steam for conventional steam turbines or may be used directly or indirectly in gas turbines.

A number of gas-cycle reactor designs have been proposed. The Daniels Reactor, the Oak Ridge School of Reactor Technology (Orsort) Reactor, and several other recent reactor designs are discussed.

Materials problems must be considered in each of these designs. Specifically, the materials for the heat-transfer medium, the moderator-reflector, the fuel elements, and the various structural elements are considered. The effect of the nature of the materials required on the over-all economics of the power systems is also given consideration.

In conclusion, some of the remaining problems and the merits of high-temperature gas-cycle systems are listed.

Furnace Performance Factors

Sulfuric-Acid Corrosion in Oil-Fired Boilers—Studies on Sulfur-Trioxide Formation.....57—A-199

By D. R. Anderson, Assoc. Mem. ASME, and F. P. Manlik, National Aluminate Corporation, Chicago, Ill. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Experimental studies on economizer and air-heater corrosion resulting from the formation of sulfuric acid in residual-oil-fired boilers are described. Factors controlling the oxidation of sulfur dioxide to sulfur trioxide have been investigated in a small experimental boiler. The fuel used was a distillate oil to which synthetic compounds were added to simulate the sulfur and metallic components commonly found in residual oils.

The sulfur-trioxide content of the flue gases was determined indirectly by measuring the corrosion of and sulfate deposition on a steel specimen maintained at a controlled temperature. In an initially clean boiler, approximately equal quantities of sulfur trioxide formed in the flame, furnace, and convection sections, while less formed in the economizer-air heater.

Nickel, iron, sodium, and vanadium in the fuel, each lessened the corrosion normally experienced by the test specimen, the magnitude of the effect increasing in the order given. Deposits of these metallic fuel-ash components in the boiler had a relatively small effect on the corrosion of the test specimen. Only the iron deposits indicated significant catalytic activity for the oxidation of sulfur dioxide to sulfur trioxide. Combinations of sodium and vanadium in the fuel were found to lessen corrosion in an initially clean furnace, but boiler deposits from certain combinations of these elements were found to increase corrosion substantially. This catalytic effect is predominant over extended periods of time.

Effect of Temperature Variation on Composition, Fouling Tendency, and Corrosiveness of Combustion Gas From a Pulverized-Fuel-Fired Steam Generator.....57—A-281

By J. D. Piper and H. Van Vliet, The Detroit Edison Company, Detroit, Mich. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

An experiment was conducted to determine the composition, corrosiveness, and fouling tendencies of the materials that condensed or otherwise deposited from the stack gas upon surfaces cooled to selected temperatures.

Metal condensers, cooled to selected temperatures between 87 and 242 F, were placed in stack gas of a pulverized-fuel-fired steam generator. The amount and nature of substances depositing upon the condensers were determined as well as the corrosion resistances of many materials. Chlorides were found to deposit at unsuspectedly high temperatures and concentrations. Corrosion rates increased markedly as the water dew point was reached.

Machine Design

Three-Dimensional Photoelasticity and Its Application in Machine Design.....57—A-87

By M. M. Leven and A. M. Wahl, Fellow ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The simplest equipment, the best model materials, and the most effective techniques for three-dimensional photoelastic tests are described. The optical equipment involves only a simple diffusion polariscope using only a single camera lens. Phthalic anhydride-cured epoxy resins, which are relatively easy to cast in large sizes, have much superior properties for photoelastic tests than previously used materials. A simple technique of using surface slices and normal incidence of light will give adequate results for the stresses on free surfaces. At interior points, the effective stress can be obtained by measuring the retardation and isoclinic parameters on the three faces of random oriented small cubes. Some discussion is given regarding methods of applying the photoelastic results in practical design applications where fatigue, repeated strain cycling, plastic flow, and creep-rupture effects may occur during operation.

Design of a Tape Reader for Numerically Controlled Positioning Machines.....57—A-204

By E. L. Fitzgerald, Assoc. Mem. ASME, Pratt & Whitney Company, Inc., West Hartford, Conn. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

There are two major classes of numerically controlled machine tools; contouring machines, and positioning machines. In contouring machines the path followed is continuous and must be described fully by the numerical data fed to the machine. In positioning machines, however, only the co-ordinates of the positioning point are fed to the machine as numerical data. The path followed to arrive at the positioning point may be programmed by built-in features in the control system.

This paper reviews the design requirements and construction features of a tape reader designed specifically for numerically controlled jig-boring machines. The reasons for selecting this type of data-handling equipment are presented, followed by the design solution and performance data.

Data required for operating this jig borer are recorded on punched tape. Coded information includes co-ordinates for locating the hole, spindle speed, speed selection, spindle rapid traverse for approach and withdrawal, and spindle depth control for drilling and boring. (57—A-204)

Human Factors Responsibilities of Design Engineers.....57—A-167

By J. L. Seminara, Picatinny Arsenal, Dover, N. J., and G. A. Peters, Los Angeles, Calif. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Engineers are recognizing more and more the contribution which has been made and is continuing to be made by those working in the field of human factors engineering. This is evidenced by the increasing demand by private industry and the military for people with such specialized training and experience. The responsibility for appropriate human factors consideration in equipment design clearly rests with the project engineer. He cannot afford to gamble several years' work and often millions of dollars and finally come up with a system which requires the operator to have three hands, two heads, or to make sensory discriminations outside the realm of human abilities.

Dynamic Characteristics of Cam Forms Calculated by the Digital Computer.....57—A-42

By S. Mercer, Jr., Mem. ASME, Michigan State University, East Lansing, Mich., and A. R. Holowenko, Assoc. Mem. ASME, Purdue University, West Lafayette, Ind. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

A simple numerical method for analyzing the residual vibrational-stress char-

acteristics of any cam form, for which the cam-acceleration function is known, is presented. This may be regarded as a generalization of prior work, because the use of a high-speed digital computer in conjunction with this method makes it possible to analyze those cams which otherwise would be impractical to consider. Results in the form of residual stress-factor curves plotted against follower-system natural frequency are given for fifteen different cam forms. In addition, a relation between the residual vibratory-stress amplitude and the resonant build-up of stress for various follower-system natural frequencies is shown. As a result, it is possible to use the residual-stress-factor curve to determine the frequencies at which resonance is likely to be troublesome, and the strength of the resonant tendency at each critical frequency for a cam with dwells of any duration.

Meeting the Engineering, Research, and Development Needs of a Medium-Sized Company . . 57—A-161

By K. R. Herman, Mem. ASME, Vickers Inc., Division of Sperry Rand Corporation, Detroit, Mich. 1957, ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

A general account is given of one company's solution to development problems created by its expansion program.

Expansion of the organization is described; separate research in the development department, development-engineering activities, research activities, basic research, and the physical plant setup are all outlined.

An Indirect Method for Determining Accelerations in Complex Mechanisms . . . . . 57—A-108

By T. P. Goodman, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

In complex mechanisms such as the six-bar, two-pivot linkage the graphical construction for determining accelerations can be simplified by starting from a point on the mechanism other than the point whose acceleration is known. Arbitrary values of velocity and acceleration can be assumed for the starting point, and the accelerations of other points can be obtained graphically on the basis of this arbitrary assumption. The accelerations so found can be converted into the actual accelerations in the mechanism by means of a simple formula which is derived in the paper.

This indirect method of determining accelerations facilitates the analysis of compound mechanisms which consist of two or more mechanisms connected in series. The method also provides a useful check on values of accelerations which have been obtained by other methods.

Second-Acceleration Analyses of Plane Mechanisms . . . . . 57—A-52

By J. C. Wolford, Assoc. Mem. ASME, University of Nebraska, Lincoln, Neb., and A. S. Hall, Jr., Mem. ASME, Purdue University, Lafayette, Ind. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Expressions are derived for three relative second accelerations which are useful in making second-acceleration analyses of plane mechanisms. Applications of these three expressions are shown by examples. The method and examples of this paper deal only with analyses of linkage-type mechanisms containing turning, sliding, and rolling pairs. Second acceleration of cam followers has already received considerable attention in the literature.

Hydraulics

Three-Dimensional Laminar Boundary Layer in Curved Channels With Acceleration . . . . . 57—A-173

By Yasutoshi Senoo, Kyushu University, Torikai, Fukuoka, Japan. 1957 ASME Annual Meeting paper (multilithographed; to be published in *Trans. ASME;* available to Oct. 1, 1958).

A theory is developed for two families of three-dimensional laminar boundary layers; namely, for the boundary layer on the parallel plane end walls of a curved channel with logarithmic spiral side walls, and for the boundary layer on the plane end wall of a concentric circular-arc channel having a particular family of accelerated or decelerated main flows. The second case shows the influence of acceleration and deceleration of a curved main flow.

Numerical calculations show that acceleration makes the boundary layer thin and deceleration makes it thick, but the variation of thickness due to pressure gradient is very small compared with that in the two-dimensional case.

The first case can be compared to the flow in a cascade. In this case, the variation of the channel width is directly related to the variation of the main flow velocity. According to the calculation, the boundary layer is thicker in an accelerated flow through a converging logarithmic spiral channel than in the decelerated flow through the same channel in the opposite direction. It is suspected that converging side walls make the end-wall boundary layer thick and that the effect of convergence is dominant over the effect of accelerated main flow. Experimental data on the end wall of a turbine-nozzle cascade were compared with the theoretical prediction, with fair agreement across the nozzle, and along the center line of the nozzle.

Study of Damaging Effects of Cavitation Erosion to Ships' Underwater Structures . . . . . 57—A-156

By J. Z. Lichtman, D. H. Kallas, C. K. Chatten, and E. P. Cochran, Jr., LCDR, USN, Assoc. Mem. ASME, New York Naval Shipyard, Brooklyn, N. Y. (multilithographed; available to Oct. 1, 1958).

The effects of fluid cavitation and cavitation-bubble collapse on a guiding surface have been investigated using two water tunnels, a magnetostrictive-transducer apparatus, a piezoelectric-transducer apparatus, and a rotating-disk apparatus.

Studies of the mechanism of damage to a surface and its relationship to change in fluid pressure and stream velocity were made. As a result of these studies and examination of numerous ships in service, the authors have arrived at certain conclusions concerning the mechanism of damage to underwater appendages. Although fluid cavitation may occur adjacent to many underwater appendages of vessels at normal operating speeds, there is considerable evidence that the areas in which cavity collapse is the primary cause of damage are restricted to propellers.

Damage to ships' struts, rudders, and other appendages is shown to be primarily corrosive in nature, aggravated by mechanical scouring action. Based on these conclusions, shipbuilding activities may take corrective action to protect ships' appendages against chemical damage and need not be concerned with protection of these structures against impact fatigue erosion associated with cavity collapse at higher stream velocities.

The Boundary Layer on the End Wall of a Turbine-Nozzle Cascade . . . . . 57—A-172

By Yasutoshi Senoo, Kyushu University, Torikai, Fukuoka, Japan. 1957 ASME Annual Meeting paper (multilithographed; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Boundary-layer flow was measured on an end wall of a turbine-nozzle cascade. The measurement reveals that the boundary layer was laminar at the throat of the

nozzle, even when the upstream boundary layer was apparently turbulent. The influence of the upstream boundary layer was studied theoretically as well as experimentally. The upstream boundary layer affected the downstream flow configuration to a certain extent, but hardly influenced the friction force on the end wall.

The observed boundary-layer thickness and wall shear stress were about 10 per cent larger than those of a theoretically estimated two-dimensional boundary layer under the same pressure distribution. Observed boundary-layer behavior also was compared with the predicted flow by a three-dimensional laminar boundary-layer theory. Agreement was satisfactory. The measurements showed the end-wall boundary-layer rolling up at the suction-surface end-wall corner of the cascade.

Water Hammer in Nonuniform Pipes as an Example of Wave Propagation in Gradually Varying Media.....57—A-107

By H. M. Paynter, Mem. ASME, and F. D. Ezekiel, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The phenomenon of pressure-wave propagation in fluid pipelines known as water hammer has now become well understood. However, nearly all solutions and solution methods are based on the assumption of one or more sections of pipe and enclosed fluid having uniform properties throughout the length. Indeed, the very mathematical existence of wavelike behavior is premised on the constancy of the transmission parameters.

Yet, it is readily appreciated that such strict constancy is altogether lacking in practical structures in which such phenomena are known physically to exist. One need only consider the numerous occurrences of bends, joints, stiffeners, anchors, and the like, in actual pipes to realize that some variation in at least the elastic properties of a fluid pipeline is inevitable. Thus the interesting question arises as to how much variation in properties can occur before the distortions in wave forms become of such practical significance and importance as to be taken into account in design and operation. A closely related problem arises in pipes whose thickness is varied to take into account variations in static and dynamic pressures. Since the latter themselves depend on the local thickness, it is easy to see that a "vicious circle" could arise in the design problem unless the order of magnitude of these variations is well understood.

Another manifestation of variation occurs in the use of some of the standard approximate formulas which replace an actual composite pipe by an assumed equivalent uniform pipe. However, the strength and weakness of such approximations are not well known.

It is the purpose of this paper to point out that the answers to these and other questions follow directly from a number of researches on propagation in variable media. These have stemmed from both the early studies of George Green in 1837, concerning the classic "Green's Law" of gravity waves in shallow channels and also an entirely independent and more recent development in electrical engineering and electromagnetic theory culminating in papers of Schelkunoff and Barthold. Some of the history behind this evolution has been recounted in a discussion by one of the authors.

Possible Similarity Solutions of the Laminar, Incompressible, Boundary-Layer Equations.....57—A-79

By A. G. Hansen, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

A review of research on the problem of obtaining similarity solutions of the three-dimensional, laminar, incompressible, boundary-layer equations is presented along with a general method of analysis for treating the problem. Restrictions on main flow velocity components and co-ordinate systems which lead to similarity solutions are tabulated. Finally, a discussion is given of the practical application of similarity solutions and the problems which remain to be solved.

The Effect of Wakes on the Transient Pressure and Velocity Distributions in Turbomachines.....57—A-83

By R. X. Meyer, The Ramo-Wooldridge Corporation, Los Angeles, Calif. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

In general, the blades of a multistage turbomachine move through a row of wakes shed from the blades of the preceding stage. This interaction between blade rows results in a transient fluctuation of the pressure distributions, which in turn can be expected to have an important effect on the drag, the maximum lift coefficient, and in the case of hydraulic machines, on the cavitation characteristics of the affected blades. In the paper, the time-dependent pressure gradient and the velocity are determined for the case of two-dimensional incompressible flow through lightly loaded cascades.

"DeCew Falls, Abitibi" Turbine Tests.....57—A-57

By A. E. Aeberli and R. A. Walker, Mem. ASME, Ontario Hydro, Toronto, Canada. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Results of Gibson Tests for efficiency and performance of the DeCew Falls, Abitibi Francis turbine are presented. This turbine was installed initially at the Abitibi Canyon station to operate under 237-ft head and was later removed and reinstalled at a new site in the DeCew Falls station to operate under 280-ft head. A comparison is developed to show the results "expected" at DeCew Falls from the original Abitibi tests versus the actual field-test results obtained at DeCew Falls.

A Theory of Lubrication in Short Journal Bearings With Turbulent Flow.....57—A-68

By L. N. Tao, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Present engineering design frequently requires the use of bearings either rotating at extremely high speed or using fluids of low viscosities as the lubricant.

When operating under either one of these conditions the well-known Sommerfeld analysis may depart from the actual results. Wilcock has shown that for a large journal bearing running at high speed there is a discrepancy between the theory and experiment to an unreasonable degree. Recently, Smith and Fuller also demonstrated the existence of flow other than the laminar nature in journal bearings. Sommerfeld has indicated that the experimental characteristics of journal bearings do not agree with the theoretical at certain large Sommerfeld numbers.

This has been interpreted to mean that the motion is no longer laminar while the analysis is based upon the law of Newtonian viscous shear. This implies that there are different natures involved in the experimental and theoretical investigations.

The present paper attempts to determine the bearing characteristics, especially the pressure distribution which relates to the load capacity of the bearing when the motion of the lubricant becomes turbulent. In engineering practice most bearings have relatively small length-diameter ratios; i.e., bearings of short lengths with respect to the diameters of the bearing. This is the type of bearing investigated in the paper.

Management

Product Development and Engineering Co-Ordination for Accomplishment in a Medium-Size Company . . . . . 57—A-236

By W. R. Hough, Reliance Electric and Engineering Company, Cleveland, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

That there is a specialized co-ordination problem between product development and engineering in the matter of total engineering responsibility, certainly cannot be denied. The purpose of this paper is to treat this co-ordination problem as a part of the total product co-ordination problem because it is in fact only such a part. The author believes it can be understood best in the light of this broader approach. The paper also considers the type of organizational structure as it affects the problems of co-ordination relating to products.

Relationship Between Engineering and Research in a Medium-Size Multiproduct Company . 57—A-235

By W. R. Spiller, Mem. ASME, Harris-Seybold Company, Cleveland, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

When a company has successfully built up its line of products through engineering, manufacturing, and merchandising, it usually has ambitions for further growth. Such growth, of course, must be obtained from additional products, and this company must think in terms then of product development. The development of its present line of products has generally been the result of the efforts of its engineering department, but the need for new products raises the question as to whether the engineering department has the capacity and the ability to develop such products. At this point, a separate group of engineers may be set up within the engineering department to accomplish the new product development and the company then considers that it has established a research department.

The paper defines the concepts of research and engineering and considers their relationships within the framework of a medium-size multiproduct company. The important differences between these functions, the resultant effects on the type of personnel required, suitable facilities, and a reasonable organizational structure are discussed.

The co-ordination of these functions are considered in detail, leading to the conclusion that probably the most important ingredient toward the success of a research endeavor is harmonious and effective working relationships with engineering.

Textile Engineering

Spinning Yarns Directly From Slivers . . . . . 57—A-202

By S. E. Patrick, Jr., Saco-Lowell Shops, Biddleford, Maine. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Spinning yarns directly from slivers has a very definite place in the future yarn mill. There are several makes of frames now on the market. The Saco-Lowell sliver-to-yarn drafting systems are relatively simple, made up of tried and proved principles, and require no special cans or containers.

With further improvements now in the experimental stage, the future holds great promise for spinning yarns directly from slivers. Improved quality and strength will provide the real reward in this newest step in yarn production—sliver-to-yarn spinning.

Oil and Gas Power

A Low-Temperature Supercharging System for Compression, Pilot-Oil, and Spark-Ignition Engines . . . . . 57—A-250

By R. H. Miller, Milwaukee, Wis. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The diesel engine for more than 50 years held the position of the prime mover having the highest thermal efficiency.

In 1951 the diesel cycle lost this position of supremacy to a spark-ignition Atkinson "perfect cycle" low-temperature supercharged gas engine when the first engine of this type was built and tested. An indicated thermal efficiency of 50 per cent, based on LHV, was reached at 210 psi mean indicated pressure.

A low-temperature supercharged dual-fuel engine using pilot oil for ignition of the air-gas mixture operates with the same high thermal efficiency.

It is a characteristic of the supercharged gas engine, whether spark or pilot-oil ignited, that the indicated thermal efficiency is constant over the entire load range, whereas the compression-ignition diesel engine loses thermal efficiency with increase in load.

Pressure Fluctuations in Multi-Cylinder Exhaust Manifolds . . . . . 57—A-196

By A. W. Hussman, The Pennsylvania State University, University Park, Pa., and W. A. Pullman, The English Electric Company, Rugby, England. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The influence of pressure fluctuations in the exhaust manifold of a multicylinder engine upon the amount of air flow through the cylinders is discussed. By analogy with torsional crankshaft vibrations a method is developed by which the pressure fluctuations at any point in the manifold can be predicted qualitatively for any system, for different firing orders and operating conditions, and for speeds near resonance conditions.

Experimental data in support of the theory are presented in the form of indicator diagrams and individual flow measurements.

Production Engineering

Roll Forming—Chipless Production . . . . . 57—A-271

By K. W. Stalker, Mem. ASME, General Electric Company, Cincinnati, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

There are three basic methods of producing mechanical products—cutting, fastening, and plastic forming. The process of working metal by plasticity is becoming increasingly appealing to the metal-working industry because of the rapid increase in material cost. This is also important because the cutting process costs money to remove the metal which is sold as scrap.

The cold-forming process, as described in the paper, is primarily used for making cylindrical and conical parts in a wide range of metals. The mechanism of the process and the interrelationship of the processing variables are described. Some of these variables are speed, feed, material, and roll geometry. Examples of some of the products are shown which indicate the process has greater versatility than originally described by the sine law.

Pearlitic Malleable Manufacture and Use . . . . . 57—A-241

By O. K. Hunsaker, Dayton Malleable Iron Company, Ironton, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The manufacturing and control processes for making pearlitic malleable castings are considered. In different grades these castings have strengths of 45,000 psi yield and 60,000 psi ultimate strength to 80,000 psi yield and 100,000 psi ultimate strength with excellent heat-treating properties, readily hardening to 62 Rockwell C. Various applications are shown, together with the availability and excellent economy of this material as compared with other materials having comparable mechanical properties.

Wood Industries

Mechanization and Automation in Small Sawmills.....57—A-48

By F. C. Simmons, Forest Service, U. S. Department of Agriculture, Upper Darby, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Small sawmills (those which produce less than 20,000 bd ft in 8 hr) are numerous and widely scattered and are more and more becoming a permanent part of many communities. Mills of this size are large enough to employ an efficient mechanized operation and considerable residue processing equipment.

A mill of the future is described. Log storage, handling, the debarking operation, the log carriage, headsaw and teeth, and other improvements are considered. Off-bearing, trimming and sorting, and resaws are also covered.

It is noted that the mill of the future presents no revolutionary changes, and practically all of the equipment mentioned is now available in sizes and at prices acceptable to the small mill.

Chain-flail log debarker. Equipment of this type can be purchased and installed economically, ready for small sawmill operation. (57—A-48)

Heat Transfer

Effect of Vibration on Heat Transfer From a Wire to Air in Parallel Flow .....57—A-100

By R. Anantanarayanan and A. Ramachandran, Assoc. Mem. ASME, Indian Institute of Science, Bangalore, India. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Studies on the effect of vibration of the heat-transferring surface on convective heat transfer are few and limited to natural-convection conditions. The present investigation deals with the influence of vibration on heat transfer from an electrically heated nichrome wire to parallel air streams. Air velocities ranged from 34 to 63 fps. At each air velocity, frequencies ranging from 75 to 120 cycles per second and different amplitudes were employed as vibrational variables. Both frequency and amplitude increased the heat-transfer coefficient. An increase as high as 130 per cent was obtained. The correlation of the experimental data shows that the proportional increase in heat transfer was controlled by the ratio of the mean vibrational velocity to the air-stream velocity.

Metals Engineering

Oxidation of Superheater Materials by High-Temperature Steam.....57—A-175

By J. Hoke and F. Eberle, The Babcock & Wilcox Company, Alliance, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Economy requires that materials employed in the construction of superheaters be used to the safe limit of their innate ability of sustaining stresses and withstanding the corrosive environment imposed upon them in service. In this connection, the question has been raised frequently as to whether the present temperature limits in use for some of the alloys could be extended upward to make more efficient use of these materials. Some work on this subject has been reported by various investigators, but information on the corrosion resistance of superheater materials to steam under actual service conditions is scarce.

In order to obtain information on the corrosion resistance of superheater materials to steam under actual service conditions, six low and medium-alloy materials were exposed at various temperature levels ranging from 950–1250 F for 7323 hr during the operation of an experimental superheater.

The results indicate that there is a narrow temperature range over which oxidation begins to increase rapidly. This transition temperature is approximately 1050 F for carbon steel and 1100–1150 F for the low-alloy steels. The addition of up to 5 per cent chromium does not add materially to the long-time oxidation resistance of low-alloy steel, but a chromium content of 9 per cent markedly increases the temperature at which oxidation becomes serious.

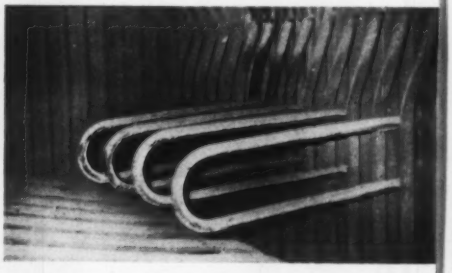
Investigation of Suitability of 18-8 (Type 304) Alloy for Superheater Service.....57—A-174

By F. B. Snyder, T. A. McNary, and F. Eberle, The Babcock & Wilcox Company, Alliance, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

An investigation of the possibility of using nonstabilized 18Cr-8Ni-type alloys as high-temperature superheater materials in place of the present practice of using stabilized 18-8 materials is discussed.

Comparative corrosion tests in synthetic steam condensates containing 38.4-ppm and 2000-ppm chloride have shown that the nonstabilized alloys, like the stabilized alloys, are not subject to intercrystalline corrosion attack in these media. Stress-corrosion tests in the same media showed that both stabilized and nonstabilized alloys suffered stress-corrosion cracking. No significant difference was observed in this respect between the two types of materials. In addition, nonstabilized 18-8 (Type 304) tubing, when installed in the pendant superheater of an operating stationary boiler, showed no intercrystalline corrosion attack after up to 54 months of service.

Experimental superheater used as test receptacle for steam-corrosion specimens installed in boiler setting (57—A-175)



Design and Properties of Silver-Indium-Cadmium Alloy Control Rods for Pressurized Water Reactor .....57—A-230

By E. F. Losco, I. Cohen, and R. R. Eggleston, Westinghouse Electric Corporation, Pittsburgh, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Design considerations pertinent to the development of silver-base alloys which fulfill physical, metallurgical, and mechanical property requirements for Pressurized Water Reactor (PWR) control rods are discussed. Silver-indium-cadmium alloys which show considerable promise of fulfilling these requirements were developed and their properties determined. Particular alloys in this ternary system display high neutron-absorption characteristics, comparable to hafnium, and excellent corrosion resistance in pressurized water (500 to 650 F).

Alloy compositions are designed to be single phase and to remain so over prolonged exposure to neutron irradiation to insure minimum change in properties upon irradiation. Physical and mechanical properties are described. Yield strength for silver-indium-cadmium alloys is lower than that of hafnium but entirely adequate for industrial power reactor applications. The alloys are quite ductile and can be fabricated easily by normal forging, rolling, and extrusion techniques.

Creep Design Workshop..... .....57—A-286

By the ASME Metals Engineering Division. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The ASME Metals Engineering Division presented an audience-participation program on creep design, that is, the design of machine parts and structures in which creep or creep rupture is encountered.

A panel of speakers introduced the subjects for discussion. Their introductory comments comprise the contents of this paper.

The workshop covered such subjects as the testing and interpretation of creep rupture data. In this connection uniaxial stress at constant temperature, cyclic stress and temperature, and combined stress were noted.

In a session devoted to creep, theories of creep, stress analysis, failure criteria, ductility requirements, and safety factors were covered.

Simulated service tests in comparison with laboratory tests, residual life of a structure after a given service, and correlation of service experience with design practice were discussed in connection with service life.

Petroleum

The Application of Safety Relief Valves to Pipelines....57—A-218

By H. L. Norris, Jr., Mem. ASME, Kinzbach Tool Company, Inc., Houston, Texas. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The major requirements for safety relief valves have been outlined by Chesler and Jesser. They are as follows:

1 With a superimposed back pressure at the valve outlet, the valve should pop when the contents of the vessel reach the set pressure.

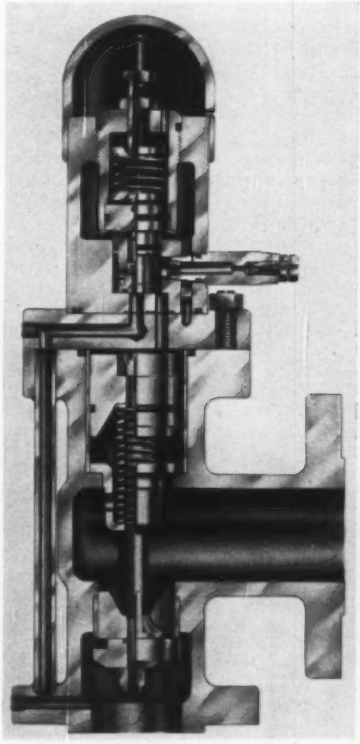
2 After the valve pops and the vessel reaches the accumulative pressure, the valve should attain its full lift and its rated capacity against back pressure.

The rated capacity should be maintained until the back pressure reaches critical and then, with further increase in back pressure, the capacity should fall off gradually, approximating as closely as possible the theoretical nozzle capacity curve for the noncritical region.

3 With superimposed back pressure, there should be little or no tendency for the relief valve to open at pressures in the vessel below set pressure.

4 The blowdown should not be excessive even with superimposed back pressure at the relief-valve outlet at the time of closing.

Pilot-operated safety relief valve for gas service fulfills four major requirements (57—A-218)



A pilot-operated safety relief valve which fulfills these requirements has been developed. A description of that valve is given along with a discussion of its applications in the oil and gas industry. Sizing of the relief valve, the possibility of its use on gas and vapor systems, rating of the valves, and malfunctions are investigated. The jet reaction of flowing gas is considered. Eccentric loading and testing of the valve are also discussed.

Steam and Electric Systems for Oil Refineries.....57—A-263

By J. G. Wilson, Mem. ASME, Shell Oil Company, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Most refineries obtain the greatest portion of their power from steam and electrical sources, although gas engines and lately gas turbines are also important contributors. Considerable difference of opinion and practice occurs in the design of these facilities. In addition, the changing nature of the type and size of power-consuming devices leads to different approaches in the design of facilities for modern oil refineries. One other factor influencing the design basis is the possible need for stand-by steam-driven equipment which is required to operate a refinery safely in the event of power failures. The increasing cost of power facilities in comparison with the oil throughput of a refinery means that greater emphasis should be given to this phase of design, and that dependability should be balanced against cost, in the selection of steam and electrical systems.

The Design of Floatingheads for Heat Exchangers.....57—A-247

By J. E. Soehrens, Mem. ASME, C. F. Braun and Company, Alhambra, Calif. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

A procedure for computing stresses in floatingheads for heat exchangers is given in this paper. The procedure takes account of the conditions of equilibrium and continuity that exist at the junction of the head and flange elements of the floatinghead. And, it takes account of the radial restraint at the gasket face. The procedure can be used to compute stresses due to external pressure as well as internal pressure.

Fuels

Problems in the Development of the BCR Automatic Coal-Fired Packaged Steam Generator..57—A-229

By P. O. Kock, Mem. ASME, Bituminous Coal Research, Inc., Columbus, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

In an effort to take advantage of the lower cost of bituminous coal, the product of modern coal mining and preparation methods, a project was initiated by Bituminous Coal Research to develop a new concept in the design of the small coal-burning steam plant.

The fundamental requirements for the development of a coal-fired automatic packaged steam generator included the following:

1 Provide a boiler-burner combination which could burn a variety of bituminous coals efficiently and could accommodate a varying load. The burner must have a quick heat-release response to sudden load increases and give economical operation over a five-to-one turndown ratio.

2 Design an automatic ash-removal mechanism to be an integral part of the boiler-burner combination to provide for accumulating the refuse discharged by the grate. This mechanism must automatically convey the refuse to a storage bin, containers, or to some other conveyer.

3 Develop a control system that would automatically co-ordinate the functions of the forced-draft and induced-draft fans, stoker, ash conveyer, and all safety limits so that the steam generator would efficiently carry wide and sudden load changes. Also the control system, in response to an external signal, must be capable of cutting the generator out of service, maintain a nonsteaming banked fire for indefinite periods of time, and again in response to a signal bring the generator up to operating conditions. All of these functions must be without manual attention.

4 The complete generator must have maximum compactness. The design of all of the components, boiler, burner, fans, ash conveyer, and controls, must permit factory assembling and testing of the assembled combination before the package is shipped to the user.

5 The complete generator must include such equipment as would insure an economically feasible product. The selling price must be competitive with the package steam generators using other fuels.

In a discussion of development problems, boiler, stoker, stoker drive, ash removal, the forced draft system, the overfire air system, induced draft, and the control system are considered.

Incremental Cost of Burning Coal in Utility Generating Stations.....57—A-187

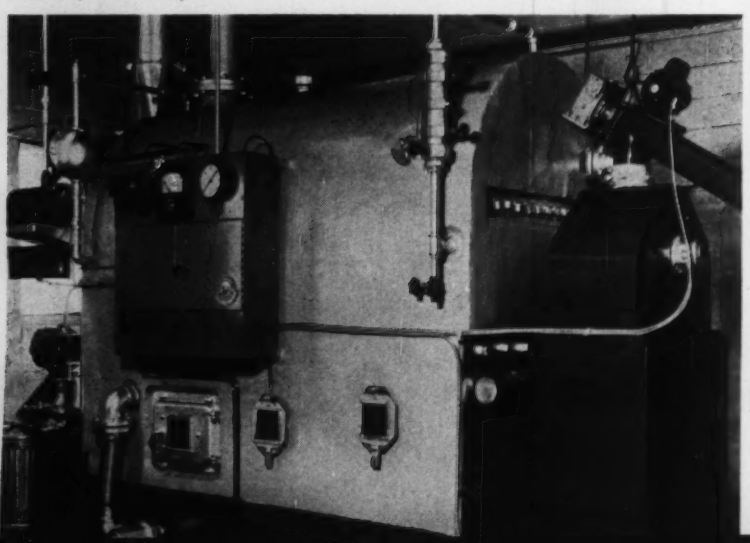
By H. B. Lammers, Mem. ASME, Appalachian Coals, Inc., Cincinnati, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Incremental costs of burning fuels and the effect of substandard combustion performance of the fuel on over-all cost of electric generation are difficult to determine. A proper evaluation of fuel costs must consider the following: Boiler efficiency, labor and maintenance, steam added for soot blowing power pulverizers, coal and ash handling, fixed charges on added investment, fixed charges on total investment outage, and added power costs during outage.

Analysis is made of a large number of utility generating stations in order to determine operating and maintenance costs as related to electric generation, coal consumption, and coal quality. Effort is made to determine the incremental costs incident to burning fuel and to determine whether additional reductions in operating and maintenance costs are possible. The relationship of incremental costs to coals of varying quality is also considered.

It is suggested that further economies in boiler-plant operation and maintenance can be effected by using quality coal, increasing station capacity, increasing automation, and operating at high load factors.

Coal-fired automatic packaged steam generator, 2500-lb per hr, low-pressure model (57—A-229)



Steam From By-Product Industrial Gases.....57—A-194

By F. G. Raynor, The Babcock & Wilcox Company, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The design of a steam generator for the utilization of heat energy in by-product industrial gases requires special consideration of the specific needs of the process involved and of the nature of the waste gas. A waste-heat boiler converts the heat energy in waste gases to useful steam for process or power requirements. Various types of waste-heat boilers have been designed for specific needs as in the production of steel, copper, zinc, and cement as well as for heat recovery from the exhaust gases from diesel engines and gas turbines.

Factors influencing the design of the boiler to achieve optimum performance as well as the recovery of process materials entrained in the waste gases are discussed. Important among these are:

1 The quantity, temperature, and specific heat of the exhaust gases.

2 The static pressure of the gas leaving the process and the draft available to overcome flow resistance.

3 The chemical and physical properties of the gas and its entrained process materials.

4 The pressure and temperature of the steam required for process or power use.

5 The degree of continuity in the rate of discharge of the exhaust gases.

Typical waste-heat boiler installations are described together with the factors effecting their design including performance data of operating units. Included in this group are clean-gas designs—a gas-tube boiler and water-tube boilers—and dust-laden waste-gas applications. This latter group includes a three-drum waste-heat boiler, and waste-heat boilers for ore roasters, a smelter furnace, and reverberatory furnace gases.

An evaluation of savings due to recovery of by-product heat energy concludes the paper.

Heat-Conduction Charts

Charts on Elastic Thermal Stresses in Heating and Cooling of Slabs and Cylinders.....57—A-238

By J. H. Hlinka, H. G. Landau, and V. Paschkis, Mem. ASME, Columbia University, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Computation of elastic thermal stresses is important in many design problems. Calculations can be eliminated by appropriate use of charts. Such charts have been developed and samples are presented in this paper. Charts hold for slabs, heated or cooled symmetrically from both surfaces or from one surface, while the other is insulated; also charts for long cylinders are available. One set of curves for an intermediate variable (N) also represents the space average temperature of a body heated or cooled by exposure to a suddenly changed ambient.

A complete set of the charts has been deposited as Document No. 5334 with the ADI Auxiliary Publications Project. A copy may be procured by citing the document number and by remitting $11.25 for photoprints, or $3.75 for 35-mm microfilm. Advance payment is required; checks or money orders are to be made payable to: Chief, Photoduplication Service, Library of Congress, and mailed to ADI Auxiliary Publications Project, Photoprint Service, Library of Congress, Washington 25, D. C.

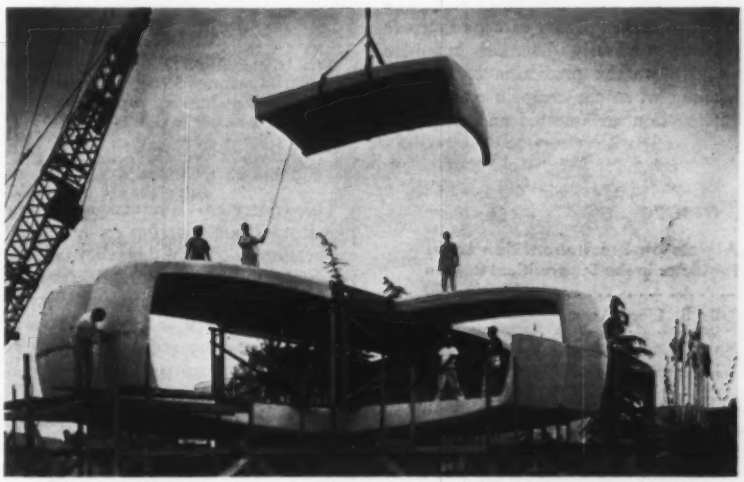
Rubber and Plastics

The Development of a Passenger Belt Conveyer Transportation System.....57—A-178

By P. W. Freitag, Jr., Goodyear Tire & Rubber Company, Akron, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The desirability of a continuous passenger conveyer system to help alleviate business area congestion is reviewed briefly. Some of the positive advantages of a properly designed system are pointed out showing how the desire for these characteristics led to the recent development of the Carveyor passenger belt conveyer system.

The operation of the system is described. Some of the unusual mechanical and rubber problems are discussed. Among them are acceleration, deceleration, belt design and tire design, type of power units, and so forth. The paper concludes by referring briefly to what the future prospects for installation appear to be.



The Plastics House of the Future. Exhibit house being erected at Anaheim, Calif. (57—A-212)

Design and Evaluation of the Plastics House of the Future.....57—A-212

By R. P. Whittier, Monsanto Chemical Company, Springfield, Mass. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The Plastics House of the Future was designed and constructed to stimulate the creative application of plastic materials in the building industry. Through this provocative approach, the design concepts which could be achieved with the new materials have been boldly demonstrated.

This paper reviews the development of the engineering approach to the problem relative to the selection of the materials, shapes, thicknesses of the parts, and several of the loading studies. Also described is the testing and evaluation program during which a full-scale "bent" section (8 ft × 16 ft in plan) was erected and analyzed for service performance while under static and thermal loading. Significant conclusions gained from this work indicate that technical data currently available on plastic materials can be used to accomplish the design of structures by the same engineering principles as are applied to standard materials of construction.

Tensile Behavior of Reinforced Plastic Laminations and Composite Plates.....57—A-208

By R. L. Thorkildsen, General Electric Company, Schenectady, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

In order for composite materials and orthotropic laminates to take their rightful place as engineering materials, expressions must be developed for the determination of their elastic properties in arbitrary directions.

In this paper, equations and curves have been obtained which describe the elastic tensile behavior of orthotropic laminations and composite plates that are loaded in arbitrary directions. The general equations are reduced to several special cases which are of particular interest to designers. The design curves greatly simplify calculation of stresses and deflections. A sample problem illustrates the use of the curves.

Prediction of Creep in Bending From Tension and Compression Creep Data When Creep Coefficients Are Unequal.....57—A-213

By W. N. Findley, Mem. ASME, Brown University, Providence, R. I.; J. J. Poczatek, Cook Research Laboratories, Chicago, Ill.; and P. N. Mathur, Assoc. Mem. ASME, Ford Motor Company, Dearborn, Mich. 1957 ASME Annual Meeting paper (multilithographed; to be published in *Trans. ASME;* available to Oct. 1, 1958).

When a material is subjected to a constant stress the time-dependent portion of the resulting strain imposed on it is referred to as creep. Although creep

behavior of materials under various states of stress is both of practical and theoretical interest, most creep data reported in the literature have been obtained with simple tensile loading. In the design of many industrial products, one of the more simple cases of complex stresses encountered is bending. The purpose of the present investigation was to develop a theory correlating the creep behavior in bending with creep in tension and compression.

In a previous paper the existing literature related to this problem was reviewed and a method for predicting creep in bending from the creep data in tension was derived. The method of predicting creep in bending from data on creep in tension previously described has been extended to the prediction of creep in bending when the creep in tension and compression are unequal and when the time-dependent and time-independent stress functions are unequal. It was shown that the stress distribution and position of the neutral axis in a beam changed with time when the creep in tension and compression were unequal; and the stress distribution changed with time when the time-dependent and time-independent stress functions were unequal. Computed creep deflections were compared with available data on canvas laminate and polystyrene, with good results for the former and fair results for the latter.

A High Shear-Rate Capillary Rheometer for Polymer Melts.....57—A-211

By E. H. Merz and R. E. Colwell, Monsanto Chemical Company, Springfield, Mass. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Data have been taken on the flow properties of polymer melts in many different kinds of rheometers, and in many cases data on the same material obtained on different types of apparatus are not comparable.

An instrument has been developed to measure the flow characteristics of polymer melts at shearing rates over the range 1–10,000 reciprocal seconds and over the temperature range 70–700 F. The derived flow parameters are independent of capillary length and diameter. It was shown that relatively large length-to-diameter ratio (L/D) of the rheometer capillary was required before viscosities could be measured independently of the capillary geometry.

The application of some results obtained from the rheometer to polymer-processing problems is discussed in this paper.

Power

A Note on Pseudotransition Locus for Water in the Supercritical Region.....57—A-200

By S. Ling, Assoc. Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The significance and the application of the concept of pseudotransition zone in so far as the practical design of the supercritical steam generators is concerned, depend in part on the probable behavior of the dissolved solids in this region in parallel with that in the subcritical evaporation. The present investigation of the solubility of various substances in this unfamiliar region is still in a premature stage. The existing data seem to suggest that the supercritical fluid is a better solvent than the subcritical fluid with solubility of various substances as an increasing function of both pressure and temperature. The present technique in feedwater conditioning has maintained dissolved solids at very low levels. However, in the absence of unequivocal experimental data suggesting otherwise, precaution must be taken to offset the probability of dissolved solids "fall out" in the presence of large volumetric expansion in the pseudotransition zone. The current practice is to effect the heating over this zone in the relatively mild heat-absorption convective surface so that probable solid precipitation would not result in overheating of scaled tubing and consequent damage therefrom. European experience with monotube, once-through type steam generators at high but subcritical pressure had suggested such a design practice.

The conceptual formulation of the pseudotransition zone has its additional application in control dynamics of a supercritical steam generator. Its response characteristics and transient behavior have been observed in pilot unit tests, and its anticipatory and regulatory functions have been incorporated in commercial designs.

Formulations for the Thermodynamic Properties of Steam and Water.....57—A-105

By H. C. Schnackel, General Electric Company, Schenectady, N. Y. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The thermodynamic properties of steam and water as presented in the well-known Keenan and Keyes' Steam Tables are expressed as formulas and condensed tables. This is done to facilitate the calculation of steam and water properties on high-speed digital computers. Methods of iteration and interpolation using these formulas and tables are discussed. Errors incurred in using the formulations as well as the ranges involved are also described.

Interpolated Tables—Enthalpy of Superheated Steam....57—A-201

By J. Madsen and W. J. Pfeifer, Jr., The Detroit Edison Company, Detroit, Mich. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

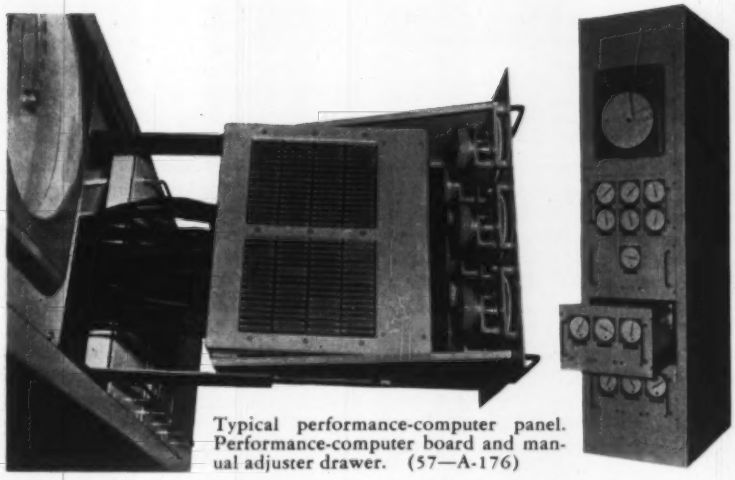
Many calculations in the mechanical engineering area are concerned with enthalpies of superheated steam. Among these are turbine heat-rate and boiler-efficiency test computations, and design calculations. The most frequently used source of enthalpies is the steam tables compiled by Keenan and Keyes. However, interpolation of tabular values is generally necessary. To effect a saving of engineering man-hours, a comprehensive table of enthalpies of superheated steam has been compiled by interpolation of Keenan and Keyes' tables using a digital computer. This paper describes the compilation and availability of this table.

The interpolated tables have been deposited as Document Number 5280 with the ADI Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D. C. A copy may be secured by citing the document number and requesting quotation for photoprints or remitting $98 for 35-mm microfilm. Advance payment is required. Make checks or money orders payable to: Chief, Photoduplication Service, Library of Congress.

The Formulation of Steam Properties for Digital Computer Application.....57—A-109

By W. G. Steltz, Assoc. Mem. ASME, and G. J. Sylvestri, Assoc. Mem. ASME, Westinghouse Electric Corporation, Lester, Pa. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Methods and equations are presented for approximating the properties of steam set forth in the Keenan and Keyes' Steam Tables. Equations and functional relationships for derived thermodynamic properties as functions of basic independent variables are presented for compressed and saturated liquid, saturated and unsaturated vapor, and superheated steam. The thermodynamic properties, enthalpy and entropy, are described



Typical performance-computer panel. Performance-computer board and manual adjuster drawer. (57—A-176)

throughout while specific volume is determined only in the superheated steam region. Error plots of incremental differences from Keenan and Keyes' values are shown as functions of the independent variables.

A Steam Properties Program for Medium and Large Computers.... .....57—A-278

By A. C. Holmes, Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., and R. S. Hollitch, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The developments in the digital computer during the past decade have provided machines of increased speed and storage capacity, together with improved reliability. Although analog and digital computers have been used by Allis-Chalmers for steam-turbine design analysis for a number of years, it has been only recently that medium and large scale computers with internally stored programs have been available. Several years ago, in anticipation of the availability of a larger computer, together with the planned growth of a computer staff, a program was initiated to code the heat-balance calculation for a steam-turbine power plant.

To assist in the development of this program, the services of the Armour Research Foundation were used. Under the direction of Allis-Chalmers, the Foundation developed the equations for the properties of steam and water, as covered by this paper, in a form suitable for computer storage and appropriate for heat-balance calculations.

Continuous Monitoring Equipment for Power Plant Cycles..... .....57—A-176

By T. S. Imsland and A. J. Hornfeck, Bailey Meter Company, Cleveland, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Recent developments in computer technology and components and the trend toward the use of large single-boiler and turbine-generating units have established the need and made possible the monitoring of cycle performance. This paper describes equipment which has been developed to monitor continuously on a real time basis by feeding information in the form of measured data of the cycle directly into an analog computer. Computed outputs such as boiler efficiency, turbine-cycle heat rate and over-all cycle heat rate are obtained which are criteria of unit performance. These outputs are indicated and recorded continuously and in some instances also may be converted into digital form for data logging.

Analysis of the Steam-Turbine Reheat Cycle.....57—A-186

By J. K. Salisbury, Mem. ASME, Atherton, Calif. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Application of a successive-approximations approach to the analysis of the steam-turbine reheat cycle has not hitherto been undertaken. Widespread use of the reheat cycle in modern power plants makes such an analysis long overdue.

It is the purpose of this paper to present a method by which the mechanism of the reheat cycle may be understood better than it has been understood in the past, in the hope that such understanding will facilitate the evaluation of various changes in the system. The methods which have been used for analysis of the simple regenerative cycle are not directly applicable in a reheat cycle. It is the second purpose of this paper to permit their application by translation of the effect of a change in the low-pressure portion into a net effect on the over-all reheat cycle.

The foregoing objectives are accomplished by presentation, first, of a new viewpoint for the reheat cycle. This is followed by an analytical determination of the gain that results from addition of reheat in an idealized manner to a low-pressure system. The use of this idealized gain for evaluating losses in the low-pressure cycle in terms of the entire plant is then presented because frequently such losses may be found for the low-pressure system by using already available methods.

Consideration is then given to analysis of the gain due to reheat that is realized in an actual cycle when the high-pressure system is superimposed on the low-pressure system. First, the effect of interconnections between the two is evaluated, and a numerical example presented illustrating the application of the method for an actual heat balance. The second component of the loss with respect to the ideal system is then analyzed, and shown to be due to ineffective use of energy in the high-pressure system.

A numerical example is presented to find the magnitude of this component which, when added to the interconnection loss, yields the total loss with respect to an ideal system.

The Thermodynamic Efficiency of the Field Cycle.....57—A-44

By J. H. Horlock, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

An analysis of the thermodynamics of the Field cycle and its several modifications is contained in this paper, but no attempt is made to discuss the practicability of the cycle. The effects of internal and external irreversibilities on over-all efficiency are considered. The efficiency of the practical Field cycle is shown to be equal to the sum of the basic Joule-Brayton cycle efficiencies less the product of these efficiencies. It is found that there is an optimum pressure ratio in the Joule-Brayton part of the cycle for maximum over-all efficiency, if maximum pressure and temperature, and condenser pressure are fixed.

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Economic Choice of Generator Unit Size.....57—A-154

By L. K. Kirchmayer, Mem. ASME, and A. G. Mellor, Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

A foremost requirement of the electric utility industry is to supply the load with a standard of reliability consistent with customer good will. To meet this requirement, reserve generating capacity must be installed on the system. Since, historically, the forced-outage rate of generating units has been about the same regardless of the unit size, the larger the size of generating units used the larger will be the reserve capacity required. On the other hand, larger sized generating units can be installed at a lower cost per kilowatt. These two opposing factors are the major considerations in obtaining an answer to the question of the most economic size of generating unit to install on a given power system.

This paper presents a method of analysis of this problem and an illustration of the application of this method to determine the most economic size of steam-electric generating units that should be added to an assumed single integrated system. A further application of similar methods has been made to evaluate the economic benefits of interconnecting areas in order to reduce the required reserve capacity. Finally, an evaluation is presented of optimum unit-size expansion patterns for integrated areas for various initial system sizes, interconnection distances, and forced-outage rates.

ASME TRANSACTIONS

THE April, 1958, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following technical papers:

Basis for the Design and Retirement of Petroleum Heater Tubes, by J. J. Heller

Recovery Ratio—A Measure of the Loss Recovery Potential of Compressor Stages, by Leroy H. Smith, Jr. (56—A-206)

Experimental Measurement of Metal-Cutting Temperature Distributions, by G. S. Reichenbach. (57—SA-53)

Shear-Zone Temperature in Metal Cutting and Its Effects on Shear-Flow Stress, by Dimitri Kececioglu. (57—SA-70)

Performance Prediction for a Process Heat-and-Power Complex by Resistance Concept, by C. F. Kayan. (57—SA-16)

The 1957 Status of Steam Properties, by F. G. Keyes. (57—A-228)

Overstrain and Bursting Strength of Thick-Walled Cylinders, by S. M. Jorgensen. (57—PET-4)

Report on Strength of Welded Joints in Carbon Steel at Elevated Temperatures. (57—PET-1)

Performance Factors of a Periodic-Flow Heat Exchanger, by T. J. Lambertson. (57—SA-13)

A Study of Heat Transfer and Pressure Drop Under Conditions of Laminar Flow in the Shell Side of Cross-Baffled Heat Exchangers, by F. L. Test. (57—HT-3)

A New Method of Heat-Exchanger Design With Specified Inlet and Outlet Conditions, by R. S. Fairall. (57—HT-5)

Dynamic Response of Heat Exchangers Having Internal Heat Sources—Part I, by J. A. Clark, V. S. Arpaci, and K. M. Treadwell. (57—SA-14)

Dynamic Response of Heat Exchangers Having Internal Heat Sources—Part II, by V. S. Arpaci and J. A. Clark. (57—HT-6)

Quasilinear Heat Flow, by N. E. Friedmann. (57—HT-10)

Heat-Transfer Rates to Cross-Flowing Mercury in a Staggered Tube Bank—II, by C. L. Rickard, O. E. Dwyer, and D. Dropkin. (57—HT-11)

Heat Transfer in Liquid Metals, by P. S. Lykoudis and Y. S. Touloukian. (57—HT-16)

Heat Transfer to Fluids With Low Prandtl Numbers for Flow Across Plates and Cylinders of Various Cross Section, by R. J. Grosh and R. D. Cess. (57—F-29)

Heat Transmission to Fluids With Low Prandtl Numbers for Flow Through Tube Banks, by R. D. Cess and R. J. Grosh. (57—HT-12)

Heat-Transfer Studies of Naval Boilers, by L. Cohen and W. A. Fritz, Jr. (57—HT-8)

Experimental Velocity and Temperature Profiles for Air in Turbulent Pipe Flow, by C. A. Sleicher, Jr. (57—HT-9)

Development of Ceramic Insulating Materials for High-Temperature Use, by W. D. Kingery, J. D. Klein, and M. C. McQuarrie. (57—HT-15)

On the Stability of Boiling Heat Transfer, by Novak Zuber. (57—HT-4)

Bubble Growth Rates in Boiling, by Peter Griffith. (57—HT-2)

Heat Transfer to Flow in a Round Tube With Arbitrary Velocity Distribution, by I. R. Whiteman and W. B. Drake. (57—HT-1)

Gas-Friction—Heat Transfer Charts for Ducted Flows, by S. V. Manson. (57—HT-34)

Combined Free and Forced Convection in a Constant-Temperature Vertical Tube, by T. W. Jackson, W. H. Harrison, and W. C. Boteler. (57—HT-13)

Heat Transfer to Supercritical Water, by N. L. Dickinson and C. P. Welch. (57—HT-7)

Modes of Adiabatic and Diabatic Fluid Flow in an Annulus With an Inner Rotating Cylinder, by Joseph Kaye and E. C. Elgar. (57—HT-14)

Nuclear Congress Preprints and Proceedings —1958 Availability List

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132 Inspection and Testing of Pressure Piping as Related to Nuclear Power Plants—ASME—V. T. Malcolm and Sidney Low, Chapman Valve Mfg. Co.

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214 Advancing Nuclear Component Design by a Construction Code—ASME—J. F. Harvey and R. M. Douglass, The Babcock & Wilcox Co.

48 The Effect of Nuclear Radiation on the Behavior of Cellulose and Cellulose Derivatives—ANS—Otto Teszler and H. A. Rutherford, North Carolina State College

198 Comparison of Activation Analysis and Danger Coefficient Analysis—ANS—M. R. Gustavson and S. Kahn, Aerojet-General Nucleonics

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135 Density Measurement of Saturated Submersed Sediment by Gamma Ray Scattering—ASTM—L. O. Timblin, Jr. Bureau of Reclamation, Denver Federal Center

136 Kilocurie Production of Barium-140—AIChE—B. M. Legler and A. L. Ayers, Phillips Petroleum Co.

45 The Release of Strain in Prince Rupert's Drops by Gamma Irradiation—ANS—C. H. Greene, New York State Ceramic College

162 The Chlorination of Mesitylene and Naphthalene in the Presence of Gamma Radiation—ACS—W. M. Sergy, J. F. Hanus, J. Oishi, J. J. Martin, and L. C. Anderson, University of Michigan

30 Control Rod Drive Mechanism for the Argonne Low Power Reactor—AIChE—W. J. Kann, Argonne National Lab.

80 Control Rod Drive Mechanisms for Hermetically Sealed Pressurized Light Water Nuclear Power Reactors—ASME—J. J. Gertz and J. W. Flaherty, Westinghouse Electric Corp.

190 A Novel Control Rod Actuator for Nuclear Reactors—ASME—Dominic Scotto and Daniel Mager, American Bosch Arma Corp.

149 Control Valves for the Homogeneous Reactor Test—AIEE—A. M. Billings, Oak Ridge National Lab.

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83 Testing Required for Full Power Operation at Shippingport Atomic Power Station—ASME—S. G. Schaffer, Duquesne Light Co.

192 Early Operating and Maintenance Experience With the Army Package Power Reactor—ASME—J. W. Barnett, E. E. Daly, and J. D. LaFleur, Jr., U. S. Army Engineer Research & Development Laboratories, Fort Belvoir, Va.

82 Direct Maintenance Practices for the Homogeneous Reactor Test—ASME—S. E. Beall, Oak Ridge National Lab.; and R. W. Jurgensen, Ohio Power Co.

184 Cleaning Nuclear Reactor Systems—ASME—A. L. Medin and R. J. Clark, Alco Products, Inc.

130 Water Treatment Process for the Dresden Nuclear Power Station—ASME—H. D. Ongman, General Electric Co.

13 Comparison of the Active With the Inactive Uranium Dioxide-Oxygen System—AIME—D. A. Vaughan and R. K. Willardson, Battelle Memorial Institute

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18 Effects of Pile-Irradiation on U_3Si—AIME—M. L. Bleiber and L. J. Jones, Westinghouse Electric Corp.

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203 Program in Design of the Yankee Atomic Plant—ASME—G. A. Reed, Yankee Atomic Electric Co.; W. C. Woodman, Stone and Webster Engr. Corp.; W. E. Abbott, Westinghouse Electric Corp.; and J. V. A. Longcor, Stone and Webster Engr. Corp.

17 The Effects of Transformation Cooling Rate on the Activation Energy Required for Recrystallization of Beta Quenched Uranium—AIME—H. R. Gardner and J. W. Riches, General Electric Co.

172 Kinetics of the Beta Transformation of Uranium—AIME—W. R. McDonell, Savannah River Lab.

178 Dimensionally Stable Uranium Alloys—ASM—A. L. Eiss and H. S. Kalish, Sylvania-Corning Nuclear Corp.

63 Electron Metallography of the U-Ni Diffusion Zones—AIME—C. L. Angerman, E. I. du Pont de Nemours & Co., Inc.

68 Chemical Operating Experience at the Army Package Power Reactor—ANS—A. L. Medin and W. S. Brown, Alco Products, Inc.

92 Long-Lived Circulating Activity During APPR-1 700-Hour Test—ACS—W. J. Small, J. L. Zegger, and A. L. Medin, Alco Products, Inc.

90 Planning for the Start-up of the Dresden Nuclear Power Station—ASME—K. T. Perkins and H. K. Hoyt, General Electric Co.

88 Proposed Fuel Handling Facilities for PRPR at Hanford—ASME—H. J. Bellarts, General Electric Co.

217 Techniques for Maintaining Water Purity in Nuclear Reactor Recycling Water Systems—ASME—W. L. Sibbitt and W. J. Rudy, Los Alamos Scientific Lab.

93 Direct Cycle Reactors for ANP—ANS—T. Szekely, General Electric Co.

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51 A Magnetic Beam Focusing and Analyzing System for Cyclotrons—AIEE—K. L. Boring, F. Edgar, and L. H. Stauffer, General Electric Co.

207 Nuclear Characteristics of Thermal Power Reactors—ASME—O. J. Woodruff, Jr., M. J. Galper, and R. T. Bayard, Westinghouse Electric Corp.

98 Performance and Potential of Natural Circulation Boiling Reactors—ASME—S. W. Flinn and M. Petrick, Argonne National Lab.

99 An Evaporatively Cooled Reactor—ASME—G. Leppert, Stanford University; and W. G. Camack, Lockheed Missile Systems Division

176 The Role of the Experimental Reactor in the Plutonium Recycle Program—ASME—R. M. Fryar, General Electric Co.

100 The Armour Dust Fueled Reactor (ADFR)—ANS—D. Krucoff, Armour Research Foundation

213 Vallecitos Boiling Water Reactor—ASME—L. Kornblith, Jr., S. Untermeyer, L. Welsh, and W. H. Nutting, General Electric Co.

151 Temperature Measurements in French Nuclear Reactors—ISA—P. Jover and P. Belin, French Atomic Energy Commission, Saclay

56 A High-Temperature Fission Chamber—IRE—J. B. Ruble and S. H. Hanauer, Oak Ridge National Lab.

123 Neutron Detector for High-Temperature Applications—AIIE—E. B. Fehr, Knolls Atomic Power Lab.

157 High-Temperature Pressure Measurement—ISA—R. J. Ingham and R. C. DuBois, Manning, Maxwell & Moore, Inc.

5 Instrumentation Experience With 2000 Psi 600 F Slurry Test Loops for Par Homogeneous Reactor Project—ISA—E. A. Goldsmith, Westinghouse Electric Corp.; and W. W. Wentzel, Pa. Power & Light Co.

205 A Simple Temperature Regulating Means for Irradiation Experiments—ASME—C. V. Moore, General Electric Co.

44 Characteristics of Reactor Fuel Process Wastes—ASCE—J. O. Blomeke, E. D. Arnold, and A. T. Gresky, Union Carbide Nuclear Co.

1 Studies on Characteristics of Savannah River Wastes—AIChE—B. Manowitz, C. W. Pierce, and S. Zwickler, Brookhaven National Lab.

185 Tracer Studies of Tidal Estuary Models—ASCE—P. J. Huiswaard, R. B. Banks, and C. G. Bell, Northwestern Univ.

40 Effects of Uranium Ore Refinery Wastes on Receiving Waters—ASCE and FSIWA—E. C. Tsivoglou, A. F. Bartsch, D. E. Rushing, and D. A. Holaday, U. S. Public Health Service

102 Radioactive Liquid Waste Disposal From the Dresden Nuclear Power Station—ASCE—C. F. Falk, General Electric Co.

174 Main Coolant Instrumentation for High Performance Pressurized Water Reactor Power Plants—AIEE—L. C. Noyes, General Electric Co.

6 Measurement of Primary Water Flow—ISA—D. E. Collins, Knolls Atomic Power Lab.

36 An Electronic Feedwater Control System for the Experimental Boiling Water Reactor—AIEE—R. H. Morse and R. N. Brey, Jr., Leeds & Northrup Co.

103 Control Systems for Boiling Water Power Reactors—ASME—R. N. Brey, Jr., Leeds & Northrup Co.

34 A New Method for the Measurement of Gases in High Pressure Water Reactor Plants—AIEE—F. C. Steiner, General Electric Co.

163 Steam Generator Instrumentation for a Nuclear Power Plant With Analog Computer Verification of Dynamic Action—AIEE—E. E. Lynch and D. P. Waite, General Electric Co.

33 Control System on a Turbine-Generator Supplying Commercial Power as a By-Product of a Nuclear Test Reactor—AIEE—H. W. Bassett, Jr., and E. R. Gasser, Knolls Atomic Power Lab.

16 Cermet Control Rod Fabrication by Powder Rolling—AIME—Samuel Storchheim, Metals Res. & Development, Inc.

62 Melting and Fabrication of a Silver Base Alloy for Control Use in Nuclear Reactors—AIME—R. J. Haffeman, W. B. Haynes, and R. W. Tombaugh, Westinghouse Electric Corp.

19 Metallurgical Design and Properties of Silver-Indium-Cadmium Alloys for PWR Control Rods—AIME—I. Cohen, E. F. Losco, and J. D. Eichenberg, Westinghouse Electric Corp.

31 A Study of Aluminum Uranium Alloys Containing Up to 45 w/o Uranium—AIME—N. E. Daniel, E. L. Foster, and R. F. Dickerson, Battelle Memorial Institute

43 LMFR Breeder Blanket Preparation by Fusion Electrolysis—AIME—M. E. Sibert, A. L. Cunningham, and M. A. Steinberg, Horizons Inc.

2 Blending vs. Re-enrichment for Slightly Enriched Uranium—AIChE—Donald Kallman and John E. Brennan, The Babcock & Wilcox Co.

15 Physical Factors in the Gainesville, Florida, Area Affecting Site Location of a One Megawatt Nuclear Research Reactor—AIME—S. O. Reichert, Univ. of Florida

106 Health Physics for an Urban Nuclear Facility—ANS—J. W. Baum, Armour Res. Foundation

46 Analysis of the Plutonium Recycle Program Reactor Hazards—ACS—N. G. Wittenbrock, General Electric Co.

148 Designer of Nuclear Laboratories—AIEE—D. I. Weinberg, Astra, Inc.

29 Nuclear Safety Considerations in the Handling and Storage of Reactor Fuels—AIChE—Norman Ketzlach, General Electric Co.

107 Core Thermal Design of Army Package Power Reactor-1A—ANS—J. O. Brondel, Alco Products, Inc.

108 An Electrolytic Analog for Reactor Heat Transfer Problems—ASME—Paul Anthony and G. Friedensohn, Nuclear Development Corp. of America

145 Heat Transfer Characteristics of Polyphenyl Reactor Coolants—AIChE—M. Silberberg and D. A. Huber, Atomics International

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202 Internal Hydraulic Effects Resulting From Mechanical Shock of a Reactor Vessel—ASME—A. S. Weinstein and C. F. Zorowski, Carnegie Institute of Technology

53 Nuclear Power Plant Transfer Functions—AIEE—H. B. Smets and E. P. Gyftopoulos, M.I.T.

50 Modular Concepts in Reactor Control Instrumentation—AIEE—J. L. Cockrell, D. F. Ryan, and J. H. Magee, Leeds and Northrup Co.

175 Reactor Power Calculator—AIEE—J. W. Adams, E. I. du Pont de Nemours & Co., Inc.

42 Considerations in the Design of the Nuclear Safety Instrumentation System for the Enrico Fermi Atomic Power Plant—AIEE—V. S. Underkoffler, Leeds & Northrup Co.; and R. G. Olson, Atomic Power Development Associates, Inc.

32 Instrumentation for a Boiling Water Reactor—AIEE—Lester Kornblith, Jr., General Electric Co.

152 Instrumentation and Control of French Thermal Reactors—ISA—P. Bonnaure, French Atomic Energy Commission, Saclay

188 Engineering Approaches to Some Materials Problems of Nuclear Power Plants—ASME—W. L. Fleischmann and S. L. Williams

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109 Dynamic Corrosion Tests of Materials in Irradiated Organics—ANS—H. Kline, N. J. Gioseffi, and W. N. Bley, North American Aviation

37 Radiation Damage Studies of Seven Non-Fissionable Metals—AIME—C. A. Bruch and W. E. McHugh, General Electric Co.

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146 Boiling Pressure Drop in Thin Rectangular Channels—AIChE—N. C. Sher and S. J. Green, Westinghouse Electric Corp.

147 Two-Phase Steam Water Pressure Drops—AIChE—H. S. Isbin and R.

H. Moen, Esso Res. and Engineering Co. R. O. Wickey, Calif. Res. Corp.; D. R. Mosher, Union Carbide Chemical Co.; H. C. Larson, University of Minnesota

27 Free Convection Heat Transfer to Water and Mercury in an Enclosed Cylindrical Tube—AIChE—J. P. Hartnett and W. E. Welsh, Jr., General Electric Co.; and F. W. Larsen, University of Minnesota

144 The Effect of a Volume Heat Source on Free Convection Heat Transfer—AIChE—I. E. Randall and Alexander Sesonske, Purdue Univ.

10 Studies of Radioactivity in the Chicago Water Supply—AWWA—J. C. Vaughn, R. W. Schmidt, Alfred Tenny, and Arthur Shor, Dept. of Water and Sewers, City of Chicago

169 Some Methods for the Determination of Radionuclides in Water in Low Concentrations—AWWA—B. Kahn and S. A. Reynolds, Oak Ridge National Lab.

143 The Use of the Gamma Spectrometer for the Identification of Radionuclides in Water—AWWA—G. R. Hagee, A. S. Goldin, and C. P. Straub, Robert A. Taft Sanitary Engr. Center

142 Laboratory Chemical Coagulation Studies on the Removal of Fallout Radioactivity in Waters—AWWA—L. R. Setter and H. H. Russell, Robert A. Taft Sanitary Engr. Center

26 Auxiliary Equipment for Radiochemical Processing—AIChE—W. E. Unger, Oak Ridge National Lab.

28 Flow Generation, Measurement, and Control—AIChE—J. Dunn and H. M. Jones, General Electric Co.

161 The Advantages of Continuous Analyzers in a Pilot Plant—ISA—C. L. Pleasance, General Electric Co.

122 Thorex Short Cooled Processing—ANS—A. B. Meservey, Oak Ridge National Lab.

191 The Movement of Strontium-90, Cesium-137, and Plutonium-239 Through Tuff Local to the Los Alamos, N. Mex., Area—FSIWA—C. W. Christenson, E. B. Fowler, G. L. Johnson, E. H. Rex, and F. A. Vigil, Los Alamos Scientific Lab.

67 The Behavior of Ruthenium in the Fixation of Fission Products—EIC—W. E. Erlebach and R. W. Durham, Atomic Energy of Canada, Ltd.

55 Treatment of Radioactive Wastes Using Ion Transfer Membranes: Removal of Bulk Electrolytes—AIChE—E. A. Mason and E. J. Parsi, M.I.T.; and A. J. Guiffrida, Ionics, Inc.

14 Geological and Hydrologic Guides to the Ground Containment and Control of Wastes at Hanford—AIME—R. E. Brown and W. H. Bierschenk, General Electric Co.

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38 The Fabrication of Stainless Steel-UO_2 Fuel Plates—AIME—W. R. Weinberger and H. S. Kalish, Sylvania-Corning Nuclear Corp.

220 The Design of Irradiation Loops—ASME—Robert Gordon, Aerojet-General Nucleonics

116 Fuel Irradiation Test Facilities—ASME—R. J. Schlitz and D. R. Patterson, Argonne National Lab.

41 Variation of the Trip Point in the ORNL Type Safety System—AIEE—J. L. Cockrell and C. W. Ricker, Leeds & Northrup Co.

35 Transistor Count Rate Systems—AIEE—L. E. Weisner, E. I. du Pont de Nemours & Co., Inc.

156 A Counting Channel Pulse Transmission Circuit—ISA—J. Parnell, Minneapolis-Honeywell Regulator Co.

58 Application of Root-Locus Analysis to Nuclear Reactor Systems—IRE—E. H. Lemon, Bendix Aviation Corp.

59 The Use of Signal-Flow Graphs in Kinetic Analysis of Nuclear Reactors—IRE—A. B. Van Rennes, Bendix Aviation Corp.

54 A Digital Program to Evaluate Transients for Nuclear Power Plant Design—AIChE—F. J. Scheib and A. J. Arker, Knolls Atomic Power Lab.

112 Variable Transport Lag Simulation—AIEE—E. G. Holzmann, General Electric Co.

138 Control of the PRPR—A Gas Balance Method With Supplementary Mechanical Shims—AICHE—J. F. Fletcher, General Electric Co.

153 New Techniques in the Simulation of Nuclear Power Plants—ISA—P. Braffort and C. Caillet, French Atomic Energy Commission, Saclay

129 Model Studies of the Flow Characteristics of the Fuel Elements for the Enrico Fermi Reactor—ASME—W. N. McDaniel and O. E. Homeister, Atomic Power Development Associates, Inc.; and R. A. Yagle, University of Michigan

133 High Temperature Fatigue Testing—With Application to Uranium—AIME—J. R. Bohn and Glenn Murphy, Iowa State College

140 A Study of the Feasibility of a Tracer System for Locating a Fuel-Element Failure in a Pressurized Water Reactor—AIChE—Meyer Pobereskin, D. N. Sunderman, Aaron Eldridge, G. D. Calkins, and Walston Chubb, Battelle Memorial Institute

206 Controlled Bowing of Fuel Subassemblies—ASME—R. E. Battu Petersen, The Franklin Institute Lab.

208 Nuclear Fuels Inspection Techniques—ASME—R. O. Hutchison, American Machine and Foundry Co.

210 X-Ray Inspection of Highly Radioactive Nuclear Fuel Elements—ASME—W. M. Barss, Atomic Energy of Canada, Ltd.

57 Design and Description of an Enriched Uranium Neutron Flux Converter—IRE—R. Anliot, R. Uyetani, R. D. Shelton, and A. R. Rana, Admiral Corp.

117 Problems in the Mechanical Design of SPERT Experimental Reactors—ASME—T. R. Wilson and W. M. Hawkins, Phillips Petroleum Co.

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187 General Electric Test Reactor Plant and Facilities—ASME—E. R. Craig, M. J. Larocco, and W. S. Prince, General Electric Co.

212 A Reactor for the Irradiation of Large Equipment Components and Assemblies—ASME—T. J. Pashos and H. M. Bass

164 Relationships Between the Universities and Industry in Nuclear Engineering—ASEE—Glenn Murphy, Iowa State College

165 Relation Between Industry and Government—ASEE—W. K. Davis, U. S. Atomic Energy Commission

166 Nuclear Training Programs for Industry Personnel—ASEE—S. J. Harris, Atomic Industrial Forum, Inc.

128 Model Studies of Coolant Flow in the PWR Reactor—ASME—F. A. Grochowski, H. R. Hazard, J. Sherman, and S. J. Flanigan, Westinghouse Electric Corp.

137 Coolant Temperature Rise in a Pressurized Water Reactor During a Loss of Flow Incident—AIChE—J. Weisman, S. Bartnoff, and G. G. Tirellis, Westinghouse Electric Corp.

177 Two Thermodynamic Systems for Molten Fluoride Reactors—ASME—B. W. Kinyon and F. E. Romie, Oak Ridge National Lab.

186 Steady-State Part-Load Characteristics of a Sodium-Heated Steam Plant—ASME—W. T. Morgan, J. E. Mahlmeister, and L. R. Blue, North American Aviation, Inc.

168 Kinetic Effects in the Partitioning of Uranium and Plutonium in the Processing of Irradiated Reactor Fuels by Extraction With Tributyl Phosphate—EIC—W. W. Morgan, W. G. Mathers, and R. G. Hart, Atomic Energy of Canada, Ltd.

22 General Economics of Chemical Reprocessing Using Solvent Extraction Processing—AIChE—F. L. Culler, Jr., Oak Ridge National Lab.

7 The Homogeneous Reactor Test Chemical Processing Plant—AIChE—W. D. Burch, Union Carbide Nuclear Co.

66 Reprocessing Costs for Fuel From a Single-Region Aqueous Homogeneous Reactor—AIChE—A. C. Jealous and R. J. Klotzbach, Union Carbide Nuclear Co.

11 The Adsorption of Radioactive Substances on Waterborne and Consolidated Materials—AWWA—F. B. Barker, U. S. Geological Survey

64 A Field Test of the Movement of Radioactive Cations Through an Underground Formation—ASCE—B. B. Ewing, University of California

47 Cross Connections: Their Prevention and Control in the Y-12 Plant of Union Carbide Nuclear Company at Oak Ridge, Tennessee—AWWA—G. J. Angele, Union Carbide Nuclear Co.

119 Reactor Shield Calculations—ANS—W. E. Edwards, General Electric Co.

9 Thermal Considerations in the Design of Concrete Structures for Shielding Atomic Power Plants—ASCE—H. S. Davis, General Electric Co.

61 Civil Engineering Aspects of the Dresden Nuclear Power Station—ASCE—J. E. Love and C. S. Darrow, General Electric Co.; and B. H. Randolph, Bechtel Corp.

121 Containment-Vessel Design Basis for the Dresden Nuclear Power Station—ASME—G. Sege, General Electric Co.

73 Design of ERB-II Primary Tank Support Structure—ASCE—R. W. Seidensticker and S. H. Fistedis, Argonne National Lab.

221 Design Aspects of Embedded Reactor Shells—ASME—S. H. Fistedis and H. O. Monson, Argonne National Lab.

8 The Nitrate Complexes of Tetravalent Plutonium—EIC—J. A. Brothers, R. G. Hart, and W. G. Mathers, Atomic Energy of Canada, Ltd.

21 Pilot Plant Fluorination or Uranium Fuel Elements by Bromine Trifluoride—AIChE—G. Strickland, F. L. Horn, and R. Johnson, Brookhaven National Lab.

39 Mechanical Disassembly of Spent Power-Reactor Fuels—ANS—W. W. Barton and J. J. Brooks, American Machine & Foundry Co.

139 Reprocessing Uranium-Zirconium Alloy Reactor Fuel Elements—AIChE—C. B. Leek, R. B. Lemon, and F. K. Wrigley, Phillips Petroleum Co.

25 Effect of Geometrical Shape on the Continuous Dissolution of Aluminum in Mercury-Catalyzed Nitric Acid—AIChE—A. F. Boeglin and J. A. Buckham, Phillips Petroleum Co.

69 Design of the Power Plant for the First Nuclear Merchant Ship—SNAME—R. L. Whitelaw, The Babcock & Wilcox Co.

Includes Letters from Readers on Miscellaneous Subjects

COMMENTS ON PAPERS

Digital Data-Collecting System

Comment by Gordon D. Craig[1]

THIS paper[2] describing an interesting digital data-processing system has a somewhat unusual design requirement of portability and flexibility permitting use in boiler-test programs at various locations. Most published literature on data-processing systems to date has covered permanent installations at specific process plants.

In my opinion, the authors have succeeded in their mission to present a straightforward approach using standard components and have developed a well-done paper. The field of process-plant data logging systems is in an early stage of development at present and is highly interesting to all engineers concerned with any phase of control systems.

The report that the DATAK system, containing some 200 relays, had experienced no relay or control failure in six weeks' service is far above average in relay reliability. These are fundamental elements in system operation, and I would like a little more detail on the types of relays used to attain the high degree of reliability.

Measurement transducers, the starting point for any data-processing system, are most important elements. DATAK is reported as using its own transducers to avoid interfering with boiler operation. Flow, pressure, and draft are three variables normally measured by pneumatic transmitters in a normal process plant with a central control station. I would like more detail on the transducers used by DATAK describing how these measurements are converted to electrical signals for the analog scanner.

Papers such as this stimulate questions, and I would like to direct the following to the authors:

1 Did any problems arise from mechanical switching at low potential and current levels in analog scanners requiring special switch design?

2 Was any feedback system incorporated into DATAK to identify quickly the item affected if a switch contact or relay malfunctions or fails?

Authors' Closure

This discussion is concerned mainly with the contacting devices and especially our apparent success with the relay contacts. We feel two features built into this system are responsible for the reliability of the relay contacts. First, the design of the contacts themselves, which were bifurcated contacts with a gold-alloy contact material; and second, the relay circuits in which the 24-volt relays were operated at 48 volts with a 300-ohm resistor in series with each relay coil. This latter feature served two purposes as it reduced the L/R factor of the circuit giving us faster pull-in and minimized the effects of relay-contact resistance.

The mechanical switching of the low-level thermocouple circuits presented no problem. The stepping switch contacts were gold plated, giving us excellent dry-circuit operation. It is to be realized, however, that the performance of the gold-plated switches will fall off with time and it is possible that after perhaps a year of substantially continuous operation, it may be necessary to replace the stepping switches.

In answer to Mr. Craig's second question, we provided, on the front panel, two groups of neon lights. One group shows the contents of the four memory units, the other group shows the action of the sequencer. These lights enable the operator to detect a serious malfunction of the system.

H. T. Hoffman.[3]
W. T. Hage.[4]

[1] Sales engineer, Foxboro Company, San Leandro, Calif. Mem. ASME.

[2] "The Application of Automatic Digital-Data-Collecting to Boiler Testing," MECHANICAL ENGINEERING, vol. 79, November, 1957, pp. 1016–1021. Based on two papers, "An Automatic Digital-Data-Collecting System for Use in Central Stations," by W. T. Hage, and H. T. Hoffman, ASME Paper No. 57-SA-58 (on which Mr. Craig comments); and "A Discussion of an Application of Automatic Digital-Data-Collecting System to Boiler Testing," by J. H. Bail, C. E. Jones, and H. T. Hoffman, ASME Paper No. 57—SA-61.

[3] Assistant staff engineer, Bailey Meter Company, Cleveland, Ohio.

[4] Electrical engineer, The Babcock & Wilcox Company, Research Center, Alliance, Ohio.

Teflon-Based Piston Ring Developments

Comment by Julius Naab[5]

THIS paper[6] is interesting and timely from the viewpoint of a compressor builder.

For many years compressors have run successfully with carbon piston rings and carbon wearing rings or tail rods. Exceptionally low wear rates have been obtained. It is not uncommon to find units whose wear rate is 0.001 in. per 1000 hr, but there are many variables in any installation which affect wear so that it is not practical to guarantee life and, as a result, 0.001 in. per 200 hr is considered good.

While the savings in oil are sizable, it should not be the determining factor in the selection of a nonlubricated compressor. Maintenance is usually greater and offsets the savings from elimination

[5] Engineer-in-charge, compressor engineering department, Ingersoll-Rand Company, Phillipsburg, N. J.

[6] "Development of Teflon-Based Piston Rings for Nonlubricated Applications," by R. D. Taber and F. A. Robbins, MECHANICAL ENGINEERING, vol. 79, September, 1957, pp. 838–841, condensed from ASME Paper No. 571—SA-67.

of oil. The important use for nonlubricated compressors stems from the end use of the air or gas being compressed and this fact should be the only governing factor in the selection of a nonlubricated compressor.

Having established the fact that nonlubricated compressors are necessary and here to stay, it is most important to search for materials which will give maximum life and minimum maintenance at a minimum cost to the user. To this end, compressor manufacturers have spent considerable money and are prepared to offer the best materials to suit any given installation, but there are certain types of gases which by their nature automatically cause extremely rapid wear and consequent high maintenance.

The worst offenders are dry gases, the dryer the gas the more rapid the wear. In this field a new material is a must and it is here where Teflon K-30 seems to offer great promise. Costs are not as important because the expense of introducing moisture and then removing it is far greater than the cost of Teflon rings.

Experiments have been conducted and the results with the use of Teflon K-30 have been remarkable—wear rates of 0.001 in. per 200 hr compressing gases with a controlled dew point as low as minus 70 per cent humidity. For this type installation no type of carbon was found which would run with a wear rate better than 0.010 in. per 100 hr.

At present, Teflon K-30 will permit offering compressors for services where carbon rings would not function. On this basis it would seem as though the manufacturer of these rings in order to compete with carbon, which is satisfactory for most applications, must find a way to reduce manufacturing costs.

Teflon K-30 is a fascinating material and one which has desirable properties.

Authors' Closure

Julius Naab's comments regarding wear rates are interesting as there is often a tendency to quote wear rates in a general fashion. The many variables associated with the service operation of nonlubricated compressors have made it necessary to determine a wear rate for each application.

The conversion or use of compressors for nonlubricated service should be carefully considered in order to realize the maximum savings from the operation. Compressor manufacturers appear to be in agreement that nonlubricated-type equipment requires more maintenance than lubricated equipment.

When a new material is developed there is an exploratory period when the material is put into many different applications to establish an ideal range of operating conditions. This is necessary to determine the field from which the most can be gained by its use.

Considerable effort has been expended since the writing of the paper to reduce the cost of rings made from K-30 material and much progress has been made along this line. We would like to thank Mr. Naab for his comments as we feel they are appropriate.

Richard D. Taber.[7]
Fred A. Robbins.[8]

[7] Design engineer, piston ring and seal section, engineering and development department, Metal Products Division, Koppers Company, Inc., Baltimore, Md.

[8] Chief engineer, piston ring department, Metal Products Division, Koppers Company, Inc., Baltimore, Md. Mem. ASME.

Steel for Canadian Pipelines

Comment by M. E. Shank[9]

The authors have written an interesting series of papers[10] on specific problems connected with the prevention of brittle failure in line pipe. In a broader sense, these papers serve to point up the difficulties and problems encountered in design of any steel structure with respect to avoidance of brittle failure.

In particular, this writer would like to discuss some of the concepts and problems contained in the second paper, and some of the test results of the third paper.

Reference is made in part 2 to the work of Robertson, and Feely, et al., in measuring the stress required for propagation of a crack. These investigators have produced excellent work of great engineering significance. This writer, however, would like to point out the necessity for distinguishing between stress for crack initiation and crack propagation. In the tests of both Robertson and Feely, plates containing edge cracks were stressed perpendicular to the crack axis. Fracture was initiated by a wedging impact force which opened up the crack. The effect of a penetrating wedge is roughly equivalent to an additional local tensile stress, and as such it initiates the running crack. Following this, the propagation of the crack is taken over by the applied tensile stress. At this instant, there is no means of measuring the actual crack length, nor does it seem possible that the testing machine is able to follow and indicate the actual load as the crack propagates across the specimen, particularly, since the crack travels at a speed up to several thousand ft per sec. It appears that the effect of the wedge and that of the crack are inextricably mixed up. It seems reasonable that the stress required for propagation is considerably less than the stress required for initiation, but this writer has doubts concerning the validity of specific numerical values attached to the former. It may well be that the stress required for propagation of a fast moving crack is much lower than 5000 psi, (1).[11]

Concerning the topic of "Metallurgical Concepts," in part 2, it is stated under item 1 that the brittle fracture concept applies only to ferritic steel. This is correct. However, the brittle failure of steel is only a particular (and temperature-dependent) case of the general topic of instability and rapid propagation of cracks. The skin failures of the British jet Comet aircraft were a phenomenon of this type. Research pointing up some of the phases of the problem for nonferrous materials has been published by Sorensen (2). Under item 8 a statement is made concerning the maximum value of stress adjacent to a notch. This might bear some clarification. Because of constraint (triaxiality) at the root of a notch the axial stress behind the root will build beyond the axial yield stress Y to some value Yn *before yielding will occur*. The ratio of Yn to Y is known as the plastic constraint factor. The plastic constraint factor can reach a maximum value of approximately 3 (3). This is quite different from the case of elastic stress concentrations which can reach quite high values. The uniaxial yield stress of a metal increases with decreasing temperature. If a notch is present the stress for flow will thus rise with decreasing temperature at a rate which is three times that in the uniaxial case. In ferritic steels, therefore, the

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[10] This comment, and those following, deals with three complete ASME papers, not the condensed version published in Mechanical Engineering, vol. 79, September, 1957, pp. 853–857. The papers are: Manufacture and Metallurgy of Flash Welded Line Pipe, Part 1, by M. A. Scheil, G. E. Fratcher, S. L. Henry, and E. H. Uecker, Paper No. 57—ASME-EIC-3; Brittle Fracture in Steel as Related to Flash-Welded Line Pipe, Part 2, by M. A. Scheil, et al., Paper No. 57—ASME-EIC-4; and Low-Temperature Burst Tests of Flash-Welded Line Pipe, Part 3, by M. A. Scheil, et al., Paper No. 57—ASME-EIC-5.

[11] Numbers in parentheses refer to the References at the end of this comment.

presence of a notch may cause the brittle strength to be reached before flow can occur by yielding (4). The existence of a brittle strength for ferritic steels has been confirmed by the work of Eldin and Collins (5). Fig. 1, due to Orowan, indicates the situation schematically. Above temperatures T_2 the material is ductile with or without the presence of a notch. Below T_1 it is always brittle. The region between T_1 and T_2 is the transition region, where the material will be-

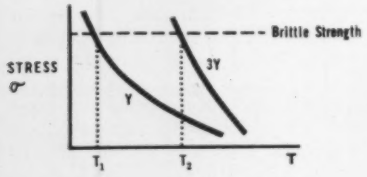

Fig. 1

have in a ductile manner under uniaxial stress, but will fail in brittle fashion if a notch is present.

Concerning part 3, this writer has read with interest of the test results and the conclusions drawn by the authors and notes that in pipe burst tests the failures exhibited cleavage with chevron markings at normal atmospheric temperatures and also at subzero temperatures. Shear-type fracture could not be obtained unless the temperature of test was raised to 180 F. Similarly, Charpy V-notch tests of pipe material indicated that the pipe material is on the lower plateau of the energy-temperature transition curve at normal service temperatures of +40 deg and below. The authors conclude that it is more economical to use commercial semikilled grade X52 steel for line pipe than to employ special alloy steels, at the same time exercising greater care in the field operations of welding and trenching than it is to procure a special alloy steel of greater notch toughness as insurance against field defects that might cause failures.

In the past, several extensive failures of line pipe have occurred in the field during test, after installation. It appears that these failures were initiated by gouging or scratching of the plate in transit or installation (6). The most recent failure appears to have occurred several years ago. It might be noted that, so far as this writer knows, no failures have occurred in pipe manufactured by the authors' company. Therefore it may be concluded that the problem of line pipe failure is a potential, if not a present one at this time. As the authors have indicated, engineering judgment must be exercised in concluding what courses of action should be taken concerning construction of future pipelines for service in subzero temperatures. In general, several courses of action are possible. One extreme is to employ a material which is so notch-tough that it will not allow propagation of a brittle failure at any conceivable service temperatures. The other extreme is to use a material which may be brittle if failure is initiated, but to eliminate the possibility of any defects which may initiate failures.

It is apparent that the elimination of defects of installation and workmanship have in the last few years markedly lowered the incidence of pipeline failures, apparently eliminating such failures completely. This may or may not provide the answer for pipelines which will operate at subzero temperatures. Certainly strict controls will have to be exercised. The great danger lies in defects which may arise in the course of service, perhaps due to mechanical bruising or from corrosion.

In so far as the Charpy test is concerned, it is a good guide to service behavior, if properly understood. It is unfortunately true that until after a series of failures has occurred of a particular class of structure, fabricated from a particular type of material, it is impossible to determine with certainty the Charpy impact energy value below which failure is likely to occur. Present correlations are available only for certain ship steels and tankage steels, and the 15 ft-lb figure so often quoted really is valid only for steels of types similar to these. See reference (7). It is entirely within the realm of possibility that economical, low alloy steels of suitable strength may be developed for line pipe, which will be above the Charpy fracture appearance transition temperature under mild service conditions, and above some suitable Charpy energy level at lower service temperatures. Thus even though failure is then by cleavage, it would not be with negligible energy absorption. In fact, the Charpy curves reported by the authors indicate that the present X-52 grade of steel is perhaps not very far from achieving this.

References

1 "Brittle Failure of Steel Structures—Theory, Practice, Future Prospects," by M. E. Shank, *Metal Progress*, June, 1955, p. 111.

2 "Some Design Considerations for Tear Resistant Airplane Structures," by A. Sorensen, *Inst. of Aer. Sci., Preprint No. 618*, Jan., 1956.

3 Theoretical Research Report, by E. Orowan, J. F. Nye, W. J. Cairns, Armament Res. Dept., MOS, No. 16/45, London, 1945.

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5 "Fracture and Yield Stress of 1020 Steel at Low Temperatures," by A. S. Eldin and S. C. Collins, Journ. App. Phys. 22, p. 1296 (1951).

6 "A Critical Survey of Brittle Failure of Carbon Plate Steel Structures Other Than Ships," by M. E. Shank, Bulletin No. 17, Welding Res. Council, 1954.

7 "Control of Steel Construction to Avoid Brittle Failure," Welding Res. Council, M. E. Shank, Editor. (Book published by the Welding Research Council, 1957.)

Comment by A. B. Wilder[12]

The authors, in part 1,[10] have presented an interesting and up-to-date discussion of the flash-welding process for line pipe. It is stated the residual compression stress in the weld zone is 30,000 to 35,000 psi in the longitudinal direction. Is this condition of stress obtained by both the hydraulic and mechanical methods of expansion, and is a similar compression stress in other areas of the pipe wall?

In flash welding, reference is made to controlled normalizing heat treatment. We would like to know under what condition the flash-weld is normalized.

In Fig. 36 the excess weld metal has not been removed by machining and this results in a reinforcement with sharp corners. If the weld metal were machined flush with the surface of the pipe the notch effect in Fig. 36 would be eliminated. Comments of the authors on excess weld metal at the welded joint will be appreciated.

The results reported for expanded line pipe with 25 years' service are of particular interest, and more information of this type would be helpful to both the producers and users of line pipe. When expanded line pipe, which is in the cold worked condition, is aged, we have observed an increase in tensile properties. We would appreciate further comment of the authors on the possibilities of aging changing the mechanical properties of expanded line pipe.

In part 3[10] the authors have presented interesting information on burst tests of line pipe at subzero temperatures. The pipe burst tested at 0 F and −50 F had a cleavage fracture but did not shatter. If the pipe had been tested with a reservoir of gas rather than brine as in a regular pipeline, the energy available would have been much greater. This would be representative of service conditions in a gas pipeline, and it is possible that at temperatures of 0 F and −50 F the pipe would shatter. Comments of the authors will be appreciated.

Low-temperature burst tests of USS T_1 steel vessels with a chemical composi-

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tion of 0.15 C, 0.92 Mn, 0.014 P, 0.020 S, 0.26 Si, 0.88 Ni, 0.50 Cr, 0.46 Mo, 0.06 V, 0.32 Cu, and 0.0031 B in the water quenched and tempered condition have been conducted. The vessels were $^1/_2$ in. in thickness, 16 ft long, and 4 ft in diam. Yield strength of the material was 108,000 to 119,000 psi and the tensile strength was 119,000 to 128,700 psi. Four burst tests were made at temperatures of −36 F to −48 F. In these tests a shear 45 deg fracture was obtained. The maximum increase in outside diameter was 0.82 per cent to 2.38 per cent in the four burst tests. The ductility transition temperature was approximately −200 F and the Charpy keyhole impact strength of the material at this temperature was $^{12}/_{14}$ ft lbs. These burst tests did not shatter and the entire fracture was in shear. It is quite possible, if gas had been used in testing, these vessels would not have shattered due to the properties of the steel.

The USS T_1 described should meet the requirement of the authors with respect to a special low-temperature steel for low-temperature service conditions. However, as the authors have pointed out, an increase in cost of pipeline construction would be involved with the use of such a special steel.

Pipeline failures result from harmful defects in the pipeline. One of the most desirable methods for eliminating harmful defects in addition to careful supervision and inspection is to properly proof-test the pipeline after its construction. All of the long gas pipeline failures with exception of those associated with hydrogen embrittlement have occurred in proof testing. When water is used for proof testing pipelines, long failures do not occur. In order to increase the safety of a pipeline, construction codes in certain areas require heavier wall material. This appreciably increases the cost of the pipeline. Comments of the authors on the use of a special tougher steel in these areas, rather than a heavier wall material with ordinary line pipe toughness characteristics, would be appreciated.

Comment by P. D. Thomas[13]

These three related papers,[10] dealing with the extension of brittle transition problems to pipe for use in transmission lines, plus further pertinent experimental work, are good papers on an interesting and important subject. The authors are to be congratulated for their fine efforts. In fact, they have made it difficult for one to comment adversely, to point out loopholes to be closed up, or to suggest further procedures.

Fortunately, the range of wall thicknesses of most line pipe (0.500 in. and under) is outside the thickness ranges which are the most subject to high brittle transition temperatures. However, the ductility requirements, for a steel to operate in a pipeline at 0 F without any danger of brittle fracture, are obviously well beyond the brittle transition properties obtained by the steelmaking and production practices normally used today. For example, the semikilled deoxidation practice in general use for line-pipe steels is not favorable to low transition temperatures.

There appears to be little chance to change deoxidation practices to any marked extent, in view of the current demand for line pipe, the production of which is now pushing 400,000 tons per month in the U. S. A. Furthermore, in view of the point made in one of the papers . . . "that to obtain 100 per cent shear fracture the service temperature must be at least 100 F over the toughness temperature required to prevent nonductile crack propagation" . . . it is doubtful that changing over to a fine-grained steel, plus normalizing, will achieve the full ductility that would be required for elimination of brittle failures at 0 F.

This situation calls for careful study by line pipe users to determine to just what extent steels with very low transition temperatures . . . for elimination of brittle failures . . . might be required in the future. The actual tonnage needs in such steel will probably be found to be quite low, even in northern climates.

Buried lines are largely protected from the low atmospheric temperatures in winter and only the above-ground portions, such as those around crossings and pump stations, will be directly exposed to zero and subzero weather. Even in these cases the temperature of the oil will have an ameliorating effect on the temperature of the pipe.

In a possible extension of the field covered by these papers, the brittle transition temperatures of the much-discussed high-strength line-pipe steels might also be considered.

Comment by Robert S. Ryan[14]

The authors are to be commended for their testing program and for providing industry with data to substantiate the use of present materials for pipelines that will operate at temperatures below the transition temperature of that material. The material is well presented and there are no conclusions that can be denied. However, the authors may have oversimplified a complex and controversial problem. There are some outstanding data available that have not been presented or considered.

There are considerable laboratory data to substantiate the information presented in this paper. For example, a great number of large-scale-tension tests have been conducted to determine the physical characteristics in relation to cleavage fractures. These tests indicate that cleavage fractures initiate from very large defects at high nominal stresses and are accompanied by considerable ductility or elongation. Many service failures initiate from small defects at relatively low nominal stresses and are accompanied by very little ductility.

The authors point out in their summary that defects in the wall thickness, such as chain marks, gouges, and the like, would not affect the test results. This information corroborates the information received from other research work, but service performance indicates that minor and seemingly insignificant defects have been points of initiation for the cleavage-type fractures. A review of the literature indicates a catastrophic ship failure that initiated from an arc strike.

The authors also indicate that it is necessary to prevent defects during construction of a pipeline in order to prevent these initiating points or triggers of the cleavage fracture. From experience, we know that this is imperative, but also from a practical standpoint, we know that it is impossible to completely eliminate such defects as gouges, dents, arc strikes, and so on, during construction.

By the same token, it is equally important to prevent the occurrence of these defects during the manufacture and transportation of the pipe. We also know that these types of defects have been initiating points of cleavage fractures.

In addition, the authors point out that in a test they conducted, the fractures did not propagate very far. Here again, the laboratory tests do not simulate service conditions because many fractures have propagated much longer distances than described in this report.

The reason the lengths of fracture described by the authors were limited to rather short distances is that they were testing with a noncompressible fluid rather than a compressible fluid such as natural gas. The authors hint that a cleavage-type fracture would propagate

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[14] Assistant supervisory engineer, Columbia Gas System Service Corporation, Columbus, Ohio.

in this material, but do not indicate that, if the cleavage fracture initiated, it would probably propagate a considerable distance. It is logical to assume that the greater energy level stored in a compressible fluid at operating pressure would appreciably increase the degree of damageability at failure.

Dr. Williams of the National Bureau of Standards has reported on the correlation of service performance with Charpy V-notch data. He indicates that the Charpy test can be used to indicate service performance. In accordance with these data, the transition temperature of the material must be below the service temperature to insure against the propagation of cleavage-type fractures.

We are afraid the article as presented by the authors would lead us into a false sense of security in using and being satisfied with the present materials.

Authors' Closure

To Prof. M. E. Shank. The authors wish to thank Professor Shank for his discussion of fundamental principles.

We agree that the stress for crack initiation and crack propagation has not been clearly defined by the work of Robertson or that by Feely, et al. However, it is a numerical value which does point out that stresses of even low magnitudes are sufficient for propagation of a crack.

It is agreed that nonferrous alloys have demonstrated instability and rapid propagation of cracks; however, these do not exhibit the peculiar temperature sensitivity noted in ferritic steel.

We welcome the clarification of the constraint values for stress at the root of a notch.

In regard to the availability of commercial steels which will exhibit some toughness in a structure at service temperatures as measured and then correlated with one of the innumerable laboratory tests; we would like to point out the following: Variations from heat to heat would rule out a guaranteed transition temperature low enough for severe service. Facilities for production of large tonnages of low alloy or even killed steels is not at present available.

To A. B. Wilder. The authors are pleased to have the discussion presented by Mr. Wilder and reply as follows:

There is 30,000 to 35,000 psi residual compression stress in the longitudinal direction of the weld area of cold expanded pipe when expansion is performed by either mechanical or hydraulic methods.

The longitudinal residual compression is balanced by a longitudinal residual tension in the remainder of the pipe section.

The mechanics of flash welding makes it possible to heat a narrow band of metal on the flashing edges of the pipe and because of the mechanical bump, applied after flashing, all of the overheated metal is extruded and later trimmed from the upset portion. The heat run back of flashing is controlled by the spread of the water-cooled electrical contact saddles and clamps and upon release of the flash welder, heat is extracted by the cold metal on either side of the weld zone. The treatment as described then constitutes a controlled thermal treatment which is similar to normalizing. Line-pipe flash welds are not reheat-treated.

The inference has been made that a notch effect is present, but you will note from Figs. 34 and 36 that the junction of the reinforcement with the pipe has a smooth radius. The reinforcement left on the weld zone has been tested in fatigue many times and the tests have demonstrated no weakness of the joint. Some of the fatigue data are referred to in reference (5) and footnote (4) in part 1.

Our data indicate no aging of line pipe after 25 years of service. Aging of cold-worked steel usually refers to the embrittling effects of certain interstitial elements which can be combined in commercial steel, especially after straining and exposure to some elevated temperature above room temperature.

Nitrogen, oxygen, and carbon are classed as interstitial elements, and when not controlled separately or in combination can result in an increase of the yield strength properties after aging with some reduction in ductility. Interstitials when precipitated to give maximum effect can also result in the raising of the transition temperature of steel.

These effects are fairly well understood, and it is no problem today to control these elements so that they do not become harmful to the mechanical properties in service.

To P. D. Thomas. The authors are grateful for the appraisal of their paper by Mr. Thomas.

We might add that some interesting information on gas pipeline temperature in low-temperature areas of Canada has been publicized by A. L. Berry, principal pipeline engineer, West Coast Transmission Company, Ltd., Calgary, Alta., Canada. In the paper by Mr. Berry and B. L. Moreau entitled "The Peace River and Alaska Highway Gas Gathering System," Paper No. 57—ASME-EIC-2, the following statement is given:

"A survey of ground temperatures in the area indicated that the gas temperature in a pipeline buried $3\frac{1}{2}$ ft below the surface does not fall below 25–30 deg F during the winter months even though the frost line may reach 8 to 10 ft."

It is thus indicated from the practical experience of others, in Canada at least, that the steel temperatures of gas pipelines should be above 0 F.

To R. S. Ryan. The authors welcome the comments of a user of gas line pipe. We cannot feel a subject such as brittle fracture can ever be simplified.

Perhaps reference to this paper as written for presentation before the annual meeting of the Engineering Institute of Canada and preprinted as ASME Papers Nos. 57—ASME-EIC-3, 4, and 5, rather than the condensed version in MECHANICAL ENGINEERING, would more clearly point out our feelings on the subject.

We agree that service failures have occurred where cleavage fractures have propagated when initiated in small cracklike defects and under low nominal stresses. The work of Robertson, Pellini, and the Esso group has shown clearly that this can be duplicated in the laboratory with suitable test specimens.

The authors wish to point out that the rounded type of defects such as chain marks in the test pipe did not (rather than would not) affect the results.

The tests reported in the paper support, not necessarily prove, our concept that pipe without sharp cracklike defects are not likely to fail due to brittle fracture in service. Thus we feel that increased supervision and inspection to prevent the occurrence of sharp defects is more economical than providing a steel with a sufficiently low transition temperature to prevent brittle failure in the presence of the severe notch. At the present, production capacity of 400,000 tons per month for line pipe of the special alloy or killed steels necessary to provide a sufficiently low-transition temperature to prevent cleavage fracture is not available.

It would be difficult to assume that fracture could proceed very far in a 20-ft test pipe. We did point out that the pipe did not shatter and that it did show ductility of the same order in the low-temperature tests as those tested at ambient temperatures. We agree that tests with a compressible fluid would be different than a test with a noncompressible fluid.

The Charpy vee-notch test can be correlated to service conditions, although generally the transition tempera-

ture must be considerably lower than service temperature. This has been covered quite fully in the formal paper.

The work of Pellini and Puzak indicates a value of 50 F lower for Charpy vee-notch transition.

The authors had no intent of lulling anyone into a false sense of security, rather the attempt was made to present the service record of expanded X52 grade line pipe, to discuss brittle fracture, and to add to the data in this field.

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[16] Director of Engineering, Tubular and Process Equipment Divisions. A. O. Smith Corporation, Milwaukee, Wis. Mem. ASME.

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Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Railroad History

Daylight Through the Mountain

Letters and Labours of Civil Engineers. By Walter and Francis Shanly. Edited by Frank Norman Walker. Research by Gladys Chantler Walker. The Engineering Institute of Canada, Montreal, Que., Canada, 1957. Cloth, 6 × 9 in., tables, illus., maps, index, xiii and 442 pp., $6.

Reviewed by Sidney Withington[1]

THIS work consists largely of letters written between 1843 and 1882 by Walter Shanly (1817–1899) to his brother, Francis Shanly (1820–1882). The brothers were born in Stradbally, County of Queens, Ireland, and emigrated by sailing packet with their family in 1836 to America, landing in New York and leaving shortly for Canada by steamboat up the Hudson, and to Oswego by canal boat and, again, by steamboat across Lake Ontario to Toronto. They drifted into civil engineering and contracting through personal association with men on the Provincial Board of Works, where "newcomers were instructed in account-keeping, drawing, surveying, field-work, and methods of calculation," the nearest approach at that time to formal engineering education in Canada. They subsequently took part (in one capacity or another) in the construction and operation of a number of pioneer Canadian railroads. Among these early railroads was the Bytown and Prescott Railway, connecting Bytown (now Ottawa) with the St. Lawrence River.

The title of this present volume refers to a much-quoted remark by brother Walter in connection with the Hoosac Tunnel in Western Massachusetts upon signing a contract in December, 1868, for its completion: "I believe we can let daylight through the mountain in four years." That job, incidentally, was the climax of the professional careers of both men. They undertook the contract with the State of Massachusetts (which was financing the project) after unsuccessful attempts by a number of previous contractors had resulted in discontinuing the work, and carried it through to a triumphant conclusion in spite of many exasperating and arbitrary requirements imposed by the State. Unfortunately, this exciting project occupies but about 30 pages in the book, as compared with several hundred pages dealing with far less dramatic episodes.

As is the case with many volumes which are based on letters written with no thought of publication, the present work is largely of interest in revealing the characters of the writers (which in this case were of the highest) rather than in any contribution of historical data, for the letters are largely devoted to somewhat trivial personal matters. However, the cumulative effect is a picture—albeit, perhaps, a somewhat vague one—of contemporary life of the period. The first few dozen pages are presented as a "prologue" and outline in a general way the professional activities of the two brothers, with quotations from letters which are reproduced in full in the main body of the book.

The title page reproduces two coats of arms, one assigned to brother Walter and the other to brother Francis. Data would have been of interest as to how the brothers came by these coats of arms. There is, to be sure, a vague hypothesis advanced by Frances E. Shanly, eldest child of Francis, but it is purely speculation.

The end papers indicate a cross section of Hoosac Mountain with a profile of the tunnel, as of Jan. 1, 1872. The tunnel was holed through November, 1874, and the first track laid February, 1875. Considerably more space in the book might well have been devoted to the drama of the Hoosac Tunnel. Data are available which redound much to the credit of the Shanlys and (unfortunately) little to that of contemporary politicians of the State of Massachusetts.

[1] Retired, formerly chief electrical engineer, NYNH&H RR, New Haven, Conn.

Aeronautics

Jahrbuch, 1956, der Wissenschaftlichen Gesellschaft für Luftfahrt

Friedr. Vieweg & Sohn, Braunschweig, Germany, 1957. Cloth, 8 × 11½ in., figs., tables, xix and 246 pp., DM 38.

Reviewed by I. Flügge-Lotz[2] and W. Flügge[3]

[2] Lecturer in engineering mechanics, Stanford University, Stanford, Calif.

[3] Professor of engineering mechanics, Stanford University, Stanford, Calif. Mem. ASME.

In the yearbook of the German Scientific Society for Aeronautics (WGL) a review of its work in 1956 is given by publishing the text of a good number of papers presented at conferences during that year, partially in co-operation with the corresponding French and Austrian societies. In addition, some papers written for a WGL annual prize competition and some original papers which did not find adequate space in the "Zeitschrift für Flugwissenschaften," are published in this volume. The different origin of the papers is clearly visible. The conference papers mostly give surveys of the achievements in the last years or in the last decade, a necessity in a country which experienced an interruption in its scientific work. However, in some of these papers new research material is added to well-known results. Among these papers are: "The Restarting of Turbojet Engines During High Altitude Flight," by F. Ferrié; "Suction in Aerodynamics," by H. Schlichting; "Physical Considerations Concerning Boundary Layer Control by Blowing Air Over Wing Parts," by Ph. Poisson-Quinton; "Flight at High Speed," by G. Bock; "Methods of Photogrammetry," by R. Förstner; "Structural Analysis by the Matrix Force Method With Applications to Aircraft Wings," by J. H. Argyris and S. Kelsey; and "Jet Noise, a Scientific and Technical Problem of Aeronautics," by E. Koppe and E.-A. Müller.

Studies of special problems are presented by O. Lutz on "Application of the Concept of Reaction Enthalpy" (used in calculating combustion temperatures of mixtures); by H. Winter on "Wheel With Meridional Acceleration as a First Stage of a Multistage Compressor;" by H. Parkus on "Stability Equations of the Helicopter;" by A. D. Young and S. Neumark on "Recovery With Fixed Elevator From a High-Speed Dive (subsonic) for Three Different Aircraft."

A group of papers is devoted to lift distribution on wings. E. Truckenbrodt's detailed paper (17 pages), on "Lift Distribution Over Wings at Sonic Speed," was originally presented at the First European Congress for Aeronautics, Dec. 14, 1954, in Paris (see also Technique et Science Aéronautiques, 1956, pp. 29–31).

This numerical method is applicable to wings of arbitrary plan form, twist, and camber; thickness effects are neglected. W. Niemz presents a "Supplement to Truckenbrodt's Wing Theory for Incompressible Flow (published in yearbook 1953 by the WGL)." K.-H. Gronau contributed "Theoretical and Experimental Investigations of Yawed Wings of Arbitrary Plan Form in Incompressible Flow." Gronau used Truckenbrodt's theory, mentioned in the preceding paper.

F. Keune and W. Schmidt report about an invariance criterion for flow along bodies in subsonic and supersonic region, which was first presented at the IXth International Congress for Applied Mechanics, in Brussels, 1956.

The last part of the volume is devoted to the papers on various subjects which were submitted to the 1955 prize competition of the WGL: "The Use of Gas Turbines as Aircraft Engines," by W. Pieper; two papers on "The Development of Airplane Components Having Low-Notch Effects," by W. Bergmann and by A. Matting, which give an interesting survey of attempts made in this direction; and "Suggestion for a New Type of Wing Structure," by O. Oeckl.

The final paper of the volume is concerned with legal questions of the mortgaging of aircraft.

BOOKS RECEIVED IN LIBRARY

ASM Review of Metal Literature, 1956
Published 1957 by the American Society for Metals, Cleveland 3, Ohio. 858 p., $6^1/_4 \times 9^1/_4$ in., bound. $15. The thirteenth annual compilation of the abstracts of the world's metallurgical literature published monthly in *Metals Review*. The abstracts are grouped into broad classes on the basis of process or property and are indexed by subjects and authors.

Aircraft Hydraulic Design
By G. R. Keller. 1957, Industrial Publishing Corporation, Cleveland, Ohio. 130 p., $6^1/_4 \times 9^1/_4$ in., bound. $4.50. This book deals with some of the problems involved in the design of hydraulic systems for high speed flight: The need for high response servo valves for use with electronic autopilots in missiles; the effect of high temperature on servos; and design for continually decreasing space. Included are chapters on properties of fluids, flow of fluids, components, and the design of actuators, valves, transmission lines, and seals.

Aircraft Hydraulic
Vol. 1, Hydraulic Systems. Vol. 2, Component Design. Edited by H. G. Conway. 1957, Chapman and Hall, Ltd., London, England. 146 and 198 pp., $6^1/_4 \times 10$ in., bound. 35s and 45s. Volume 1 covers fluids, hydraulic theory, general system problems and circuits, and system installation and testing. Volume 2 deals with seals, pumps and motors, selectors, valves, piping, and servo-controls. The volumes are part of a series sponsored by the Royal aeronautical Society and intended both as texts for students and as manuals for practicing engineers.

American Civil Engineering Practice
Vol. 3. Edited by R. W. Abbett. 1957, John Wiley & Sons, Inc., New York, N. Y. Various pagings, $5^1/_2 \times 8^1/_2$ in., bound. $25. The third volume of this important new reference work presents the fundamental principles, procedures, and data for the following section headings: theory of structures; masonry and plain concrete; reinforced concrete, including detailed design of members; prestressed-concrete structures; footings, piers, and abutments; retaining walls; steel and reinforced-concrete bridges; steel towers, tanks, bins, etc.; concrete chimneys, silos, tanks, etc.; timber structures; steel-framed and reinforced-concrete buildings, including structural planning; earthquake-resistant design.

Atomic Energy Applications With Reference to Undeveloped Countries
By B. C. Netschert and S. H. Schurr. 1957, The Johns Hopkins Press, Homewood, Baltimore, Md. 129 p., 6×9 in., paper. $2. The first part of this booklet reviews the uses of nuclear energy. Part 2 discusses the conditions necessary for using nuclear energy in terms of meeting requirements in cost and resources and in terms of conditions necessary to derive any benefit from a particular use. The last part of the book describes the activities already undertaken to initiate nuclear energy programs in underdeveloped countries.

Basic Automatic Control Theory
By G. J. Murphy. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 557 p., $6 \times 9^1/_4$ in., bound. $9. The basic theory pertinent to the analysis and synthesis of linear control systems having only fixed, lumped parameters, and subject to input commands and disturbances which can be specified with certainty is the subject of this college textbook. Among topics covered are types of control systems; ultimate-state, frequency, and time response; and introduction to use of the analog computer.

Boron, Calcium, Columbium, and Zirconium in Iron and Steel
By R. A. Grange and others. 1957, John Wiley & Sons, Inc., New York, N. Y. 533 p., $5^3/_4 \times 9^1/_4$ in., bound. $14. The fourth volume of the Alloys of Iron New Monograph Series brings together essential information on boron, calcium, columbium (plus tantalum), and zirconium as alloying metals in iron and steel. The material gathered here has been culled from the technical literature of the world, from material scattered through journals and books in many languages and is presented in English. There is an excellent bibliography, name indexes, and a thorough subject index.

Brennharten
Edited by H. W. Grönegress. 1957, Vulkan-Verlag, Dr. W. Classen, Essen, Germany. 196 p., $4^1/_2 \times 6^1/_2$ in., bound. DM 9.60. A pocket-size manual on flame-hardening and localized heat-treatment, especially for users of the Peddinghaus process. Part 1 covers equipment operation and maintenance, materials, testing for depth of hardness, how to achieve uniform results, cost calculations, and an extensive bibliography. Part 2 presents tabular data on equipment types, gases, thermodynamics, flame-hardenable materials, etc.; and Part 3 contains photographs of equipment.

Hygrometry
By H. Spencer-Gregory and E. Rourke. 1957, Crosby Lockwood & Son, Ltd., London, England. 254 p., $5^1/_2 \times 8^3/_4$ in., bound. 36s. The measurement and control of humidity in industrial processes is becoming increasingly important. This book is a thorough survey of the scientific principles of practically every

known type of hygrometer: frost point, dew point, condensation, hair, diffusion, electrolytic, gravimetric, etc. Also treated are a number of related topics such as the vapor pressure of water and ice, the vapor pressure of solutions, and the moisture content of highly compressed permanent gases.

Industrial Organization and Management
By Ralph C. Davis. Third Edition, 1957. Harper & Brothers, New York, N. Y. 953 p., 6 × 9½ in., bound. $8.25. Intended for industrial executives as well as for students of management, this book emphasizes fundamental objectives, policies, and methods of approach to the solution of business problem. The 31 chapters of the book cover a wide range of subjects including plant location, plant maintenance, product and process planning, marketing, office management, etc. The numerous examples of management practice have been taken from a variety of manufacturing companies.

Instrument Technology
Vol. 3—Telemetering and Automatic Control. By E. B. Jones. 1957, Butterworth Scientific Publications, London, England. 198 p., 6 × 10 in., bound. 40s. The present volume in this series deals in a brief section with pneumatic and electrical telemetering systems, and in more detail with the instruments and mechanisms for automatic control of processes. As in previous volumes basic principles are discussed before the actual instruments, and the instruments are classified according to the physical principle upon which they are based.

The Manufacture of Iron and Steel
Vol. 1—Iron Production. By G. Reginald Bashforth. Second Edition, 1957. Chapman & Hall, Ltd., London, England. 306 p., 5⅜ × 8¾ in., bound. 45s. Volume one of this series is a comprehensive survey of the subject of modern methods of iron manufacture from the occurrence and classification of iron ore to the manufacture of ferro-alloys, special irons, and wrought irons. The blast furnace is thoroughly covered with chapters on blast furnace fuels, reactions, slags, equipment, design, refractories, operation, and calculations. Several other methods of pig iron production such as the electric reduction furnace are discussed. Many references are included after each chapter, and there is a short bibliography at the end.

Manufacturing Processes
By Myron L. Begeman. Fourth Edition, 1957. John Wiley & Sons, Inc., New York, N. Y. 612 p., 5⅞ × 9¼ in., bound. $8. Starting with the foundry process, this book presents a comprehensive survey of the technical fundamentals of important manufacturing processes involving engineering materials such as the ferrous and nonferrous metals, alloys, and plastics. The mechanisms and operations of the modern machine tools involved are described, as well as the inspection and gaging of the finished products. New chapters are those on manufacturing processes, electroforming, metal-coating processes, and metal cutting. New topics discussed include electrospark and ultrasonic machining, chemmilling, and automation. References and numerous illustrations are included throughout.

Mechanical Vibrations
By Bernard Morrill. 1957. The Ronald Press Company, New York, N. Y. 262 p., 6 × 9¼ in., bound. $6.50. This introductory text for undergraduate or graduate students aims to present basic vibration theory from a mathematical point of view which will be sufficiently rigorous to permit advanced study of mechanical vibrations. Adequate grounding in integral calculus is presupposed in this book which utilizes the second order linear differential equation, partial derivatives, and Lagrange equations in its treatment. Chapters cover the dynamics of a particle, systems with a single degree of freedom and with several degrees of freedom, beams, and shafts, and the final chapter deals with electrical-mechanical analogy, mobility method, and analog computers.

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Microwave Principles
By Herbert J. Reich and others. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 427 p., 6 × 9¼ in., bound. $8.75. Essentially an abridgement of the authors' "Microwave Theory and Techniques" (1953), this text has been prepared for a senior course in communications and for practicing engineers who want to review the fundamentals of microwave devices. Similar in content to the earlier book but without the mathematical detail, this book covers transmission lines, waveguides, impedance matching, antennas, resonators, magnetrons, traveling wave tubes, and the theory and characteristics of amplifier and oscillators.

Nuclear Power Engineering
By H. C. Schwenk, R. H. Shannon, and B. G. A. Skrotzki. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 319 p., 5⅜ × 8¼ in., bound. 6.50. An elementary presentation of the basic facts of the physics, design, materials, economics, and operation of nuclear power plants. The material is a revised and augmented reprint of a series of articles published in POWER, starting in July, 1954.

Nuclear Reactor Physics
By Raymond L. Murray. 1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 317 p., 6 × 9¼ in., bound. $10. Prepared for use by the graduate student in science or engineering and the design engineer in the nuclear energy field, this book discusses the physical concepts and calculation methods involved in the analysis of the behavior of an assembly of fissionable material. The principal emphasis is on three major topics: the distributions in energy and space of neutron flux, the determination of the critical amount of fissionable material, and the transient behavior and control of the reactor as a heat source.

Optical Methods for Examining the Flow in High-Speed Wind Tunnel
(Agardograph 23.) Part 1—Schlieren Methods, by D. W. Holder and R. J. North. Part 2—Interferometer Methods, by G. P. Wood. Published 1956 by the Advisory Group for Aeronautical Research and Development, Paris, France. 148 p., 8 × 10½ in., paper. Price not given. This paper is a review of the present state of knowledge on the use of schlieren, direct shadow, and interferometer techniques for visualizing and photographing the flow in high-speed wind tunnels. Emphasis is placed on the most widely used techniques although there is some discussion on methods which are as yet in an early stage of development. Data on suitable light sources and photographic materials are included.

Physics of Non-Destructive Testing
Supplement No. 6, British Journal of Applied Physics. Published 1957 by The Institute of Physics, London, England. 72 p., 8 × 10¾ in., paper. 25s. A collection of 11 papers and two panel discussions, published to give engineers and metallurgists an insight into newer methods of nondestructive testing and their uses. The papers deal with such subjects as mechanical testing of nonmetallic materials, x-ray diffraction, nuclear magnetic resonance, optical fluorescence, and the ultrasonic pulse method. Brief symposiums on optical, surface, and penetrant methods are included.

Quality Control and Statistical Methods
By Edward M. Schrock. Second Edition, 1957. Reinhold Publishing Corporation, New York, N. Y. 246 p., 6 × 9¼ in., bound. $6.75. Intended for those with little knowledge of the field, this second edition presents the most generally useful modern techniques of quality control and statistical methods as applied to industrial problems of product quality. Subjects covered include the nature and economic objectives of quality, the means of presenting information pertaining to quality, the applications of various types of control charts, the various modifications of control limits, probability distribution and significance of differences, and the nature of acceptance sampling. New material has been included on rapid approximate tests of significance and analysis of variance.

Standard Method for Testing Petroleum and Its Products
16th Edition, February, 1957. Published by The Institute of Petroleum, London, England. 772 p., 5½ × 8⅜ in., paper. L2. A compilation of over a hundred adopted or tentative methods covering acidity, carbon residue, distillation processes, cloud and pour points, viscosity, etc. This edition includes four new methods, 21 revised methods, and a few revised specifications.

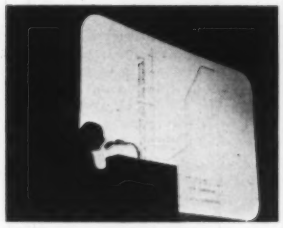
Technical Descriptive Geometry
By B. Leighton Wellman. Second Edition, 1957. McGraw-Hill Book Company, New York, N. Y. 628 p., 6 × 9¼ in., bound. $5.75. Written in simple language with many illustrations, this book provides a comprehensive and modern treatment of the theory and practical applications of descriptive geometry for the student and industrial draftsman. Two new chapters on vector applications and geology and mining applications have been added. This edition also contains an improved presentation of visibility, perpendicular lines, views of a circle, and cylinder intersections.

Die Verhüttung von Aluminiumschrott
By Kurt Schneider. Second Edition, 1957. Metall-Verlag GMBH, Berlin, Germany, 254 p., 5¾ × 8¼ in., bound. DM 19.50. A revised edition of a book on the smeltinn of aluminum scrap which surveys current installations and methods. Particular emphasis is placed on new types of furnaces for the melting of chips and scrap metal and on recently developed refining procedures.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP



fourth nuclear engineering and science conference

Process heat applications, new reactor types, among high lights

R. M. Nixon
principal speaker

L. L. Strauss
toastmaster

J. R. Dunning
banquet chairman

THE 1958 Nuclear Congress, co-ordinated by the Engineers Joint Council and sponsored by 29 engineering and scientific societies, of which The American Society of Mechanical Engineers is one, as well as two management associations, was held in Chicago, Ill., March 17–21, 1958.

Most of the sessions of the fourth Nuclear Engineering and Science Conference and the sixth Hot Laboratories and Equipment Conference were held at the International Amphitheater, which also housed the Atomfair. The Atomic Energy Management Conference sessions, March 17–19, were held at the Palmer House, which was also the headquarters hotel and the location of the All-Congress Banquet. A total of 1932 registered for the various conferences.

Over 100 industrial concerns, United States and foreign government agencies, publishing concerns, scientific, and engineering research societies exhibited at the Atomfair; viewed by 11,373.

"Industrializing the Atom" was not only the theme of the 1958 Nuclear Congress, but a good description of the degree of progress reported in the technical papers. Nuclear power for the generation of electricity by the boiling-water and pressurized-water systems was an accomplished fact and emphasis for these concepts was on training, operation, and maintenance procedures. Breeder systems, the new pressure-tube reactor, liquid-metal-fueled, organic-moderated, and homogeneous systems were among those whose basic research problems were being solved in anticipation of engineering the next families of reactors.

Inspection trips were arranged daily through Thursday to the Dresden Nuclear Power Station and to the Argonne National Laboratory.

The American Society of Mechanical Engineers sponsored the largest group of papers, more than 65, and according to John R. Dunning, Mem. ASME, banquet chairman, and chairman of the Nuclear Congress Policy Board, "The 1958 Nuclear Congress established a new high both in breadth and technical depth."

Vice-President Nixon Banquet Speaker

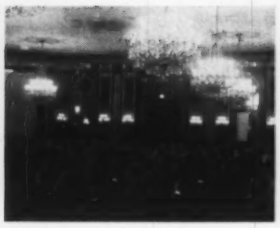
Lewis L. Strauss, chairman of the Atomic Energy Commission, introduced Vice-President Richard M. Nixon who delivered a major address on some matters of government policy, particularly as it related to the space program and the type of government agency that should have primary responsibility. He referred to the summit negotiations, stating that the Russians were blocking progress by insisting on conditions they know are doomed to failure. In closing, he stressed the importance of the development of the peaceful uses of atomic energy and the part played by those present.

An article based on his address appears on pages 56 and 57 of this issue.

Technical Sessions

Space and Process Heating. The application of nuclear energy to space and process heating has become of major importance since the technology for electric-power generation has progressed so far. Although this market is numerically larger than that for utility boilers, capacities and pressures are generally lower, and other operating requirements quite specialized. A market analysis

nuclear congress



(181)[1] has shown that the primary metals industry is the largest user of nonpower heat, followed by petroleum and coal products, fabricated metal products, and chemical and allied products, in that order. A number of possible methods were presented (100 and 180). The most unusual was the Armour dust-fueled reactor, to be described more fully in a future "Briefing the Record" section.

Conceptual Studies. A novel conceptual study was the evaporatively cooled reactor whereby useful quantities of vapor can be generated directly from a reactor coolant, without ebullition in the reactor core, and utilized directly as the turbine fluid (99). Two thermodynamic systems were analyzed for liquid-metal-fueled reactor systems (177) with two liquids between the steam and fuel salt, or helium as the intermediate fluid. Flinak—LiF–NaF–KF, and LiF–NaF–BeF_2 mixtures are available as the primary coolant.

Plutonium Recycle. Within the past year, substantial effort has been made to reduce the plutonium recycle to a practical power-reactor technique (88, 125, 176, 189, and 204). Plutonium used as part of the fuel charge would be self-sustainingly recycled ad infinitum to generate enough plutonium to supply all the reactor's requirement for enrichment other than any which may be present in the feed fuel. Sufficient U-235 or Pu-239—which need not be an extraordinarily large quantity—could be provided when the reactor is first started, or outside enrichment could be added as the cycle is depleted. Heavy-water moderated and cooled vertical-pressure-tube-type reactors are considered best for this application (176).

Progress Reports. Progress reports were given on reactors in the construction or operative stages. Quarter-scale flow models (128), and the pre-operational testing of the pressurized-water reactor at Shippingport, Pa., were reviewed (83), and the $\$^3/_4$-million training program for the 102 total operating personnel of the Dresden Boiling Water reactor outlined (90). The latter program involves up to five years of training for some of the key positions. These are radiation-protection, thermal, and instrument engineers, and a chemist. Varying amounts of training are given the junior engineering and technical supporting personnel.

The Enrico Fermi fast-neutron breeder reactor in Monroe County, Mich., is still in the experimental stage although construction has been in progress since August, and design is being completed as the work progresses in order to save the additional two to five years that would be necessary if experimental development were completed first.

The Army Package Power Reactor at Fort Belvoir, Va., has nearly completed its first year of operation without any failure attributable to the reactor itself (192). Refueling can be accomplished in 24 hours, and extensive research is being done on corrosion problems and the nuclides to be anticipated under the wide variety of water conditions that will be encountered. Other reactors for specialized applications, based on the APPR type, will appear within a year or two (68 and 92).

Three full-scale experiments with components for the homogeneous reactor test at Oak Ridge, Tenn., are in progress (127), diaphragm-feed pumps have been tested (74), and specialized maintenance procedures are being developed for operation with all or part of the reactor submerged in water. It is hoped, however, that "dry" operation will be possible (82).

The "definitive design" for the Yankee pressurized-light-water reactor to be installed near Rowe, Mass., is following the "reference design" of a year and a half ago. The only notable change is a reduction in the physical size of the first core to be installed (203). Fuel will be UO_2 in the form of sintered pellets.

The pressurized-light-water plant which Consolidated Edison is constructing at Indian Point, N. Y., will use fully enriched uranium as the base fuel, in the form of uranium oxide (urania) and will utilize thorium oxide (thoria) as the fertile material. Both materials are homogeneously mixed and incorporated in rod or pin-type fuel elements clad with stainless steel. The four unusual steam boilers, one for each coolant loop, consist of a U-tube, lower heat-exchanger drum, and a straight upper separator drum supported on the connecting risers and downcomers (131).

Boiling-Water Reactor Performance. The boiling-water-reactor type, exemplified by the Experimental Boiling Water Reactor at Argonne National Laboratory, which was dedicated in February, 1957, and the Vallecitos, Calif., plant which went critical in August (213), is being extensively studied in performance and potential (98) with the particular ob-

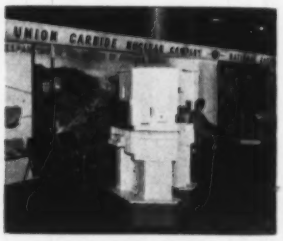
[1] Numbers in parentheses refer to papers shown in the Availability List pp. 113–115.

Speakers on Power Reactor Development

W. E. Abbott, Westinghouse Electric; Walter C. Woodman, Mem. ASME, Stone and Webster; O. G. Hanson, Consolidated Edison; Norman Hilberry, session chairman, director, Argonne National Lab.; and R. W. Hartwell, Mem. ASME, of Power Reactor Development Corporation, ***reading top to bottom***

nuclear congress

Booths at Atomfair



jective of reducing the cost of power generation. Papers on the containment-vessel design (121), and water-treatment processes (130) for the Dresden station under construction near Chicago, Ill., were presented, as well as a paper on control systems for this type (103), and the training program already mentioned (90).

Mechanical Shock. Mechanical shock to reactor vessels has become of importance for marine installations because of the possibility of collision, or—in the case of naval vessels—explosion. Shock analysis (201) and the internal hydraulic effects (202) were treated.

Codes. Codes are becoming increasingly important as the reactor art develops, with attention being given to the scope of pressure-vessel codes and activities toward improved content (78), code problems (79) advancing nuclear-component design (214), and the inspection and testing of pressure piping (132), as well as leak-tightness inspection of plants and their components (200).

Heat-Transfer Analog. Two-dimensional steady-state reactor heat-transfer problems can be solved with an electrolytic analog that is in the pilot-model stage. As many as 7920 electrodes can be located on a $^1/_2$-in-sq grid provided on the tank bottom for the installation of electrodes and input-current circuits. Voltage and position readings of the analog instrumentation can be plotted to determine the isothermal regions, and various geometries can be simulated through the use of plexiglas forms. Tests of a problem with a known solution resulted in a maximum error at any point of 2.35 per cent (108).

Test Reactors and Irradiation Facilities. Aspects of various test reactors and irradiation facilities were described, including the special Excursion Reactor Tests, SPERT, at the National Reactor Testing Station near Arco, Idaho (117); GE's 30-mw test reactor at Vallecitos, Calif. (187); a high-power intermediate-enrichment pool reactor (118); the physics of a reactor for the irradiation of bulky materials and equipment (126); a 10-mw radiation-effects reactor (212); two fuel-irradiation test facilities at Argonne National Laboratory (116); as well as temperature-regulating means for irradiation experiments (205); and the design of irradiation loops (220).

Other papers were on control rods (80 and 190), fuel-element inspection (208 and 210), fuel-element bowing (206), radioactive liquid-waste disposal (102), model studies of flow characteristics (129), steady-state performance and part-load characteristics (179 and 186), as well as the nuclear characteristics of thermal-power reactors (207). A new topic was the cleaning of nuclear-reactor systems (184), and there were studies of the engineering approaches to some materials problems (188), the development of a welded seal for a reactor-vessel head (167) and on the operation of 3000-gpm sodium pumps (183).

The 1959 Nuclear Congress will be held in Cleveland, Ohio, April 5–10.

PEOPLE

Honors and Awards. KARL ARNSTEIN, Fellow ASME, and retired vice-president, Goodyear Aircraft Corporation, Akron, Ohio, has been awarded the Navy Distinguished Public Service Award. The award, the highest honor which the Navy can grant to a civilian, was presented for his outstanding contributions to the Naval Establishment in the fields of scientific research and development.

T. C. WISENBAKER, assistant manager, T. L. PHILLIPS, manager and chief engineer, Missile Systems Division, Raytheon Manufacturing Company, Bedford, Mass.; and J. H. LIEPER, manager, Raytheon, Oxnard, Calif., received the Navy Meritorious Public Service citation for outstanding contributions to the Navy in the field of guided-missile technology.

E. A. PRENTIS, Spencer, White and Prentis, New York, N. Y., is the recipient of the 1958 Alexander Hamilton Medal. The medal is awarded annually by the alumni of Columbia College to a former student or member of the College faculty "for distinguished service in any field of human endeavor."

MORRIS GOODKIND, director and chief bridge engineer of the New Jersey State Highway Department, has received the 1958 Eggleston Medal. The medal is Columbia University's highest engineering award and is presented for "distinguished engineering achievement."

K. M. IRWIN, Fellow ASME, vice-

May 19

Engineers Joint Council, regional meeting, Sherman Hotel, Chicago, Ill.

May 19–23

American Foundrymen's Society, castings congress and foundry show, Cleveland, Ohio.

May 22–23

American Iron and Steel Institute, 65th general meeting, Waldorf-Astoria, New York, N. Y.

May 26–28

American Society for Quality Control, 12th national conference, Statler, Boston, Mass.

May 27–31

International Study Days on Modern Thermal and Hydraulic Power Stations, Palais des Congrès, Liége, Belgium.

May 29–June 8

Association of Engineers and Architects in Israel and Israel Institute of Technology, first world assembly, Haifa, Tel-Aviv, and Jerusalem, Israel.

MEETINGS OF OTHER SOCIETIES

June 2–4

AIEE, ARS, ISA, and IAS, 1958 National Telemetering Conference, Lord Baltimore Hotel, Baltimore, Md.

June 2–5

American Nuclear Society, fourth annual meeting, Statler Hotel, Los Angeles, Calif.

June 2–6

National Association of Power Engineers, national convention, Ambassador Hotel, Atlantic City, N. J.

June 9–12

1958 Materials Handling Show, by Clapp & Poliak, in conjunction with ASME Materials Handling Conference, Public Auditorium, Cleveland, Ohio.

June 9–13

National Bureau of Standards, conference on weights and measures, Sheraton-Park Hotel, Washington, D. C.

June 9–21

International Organization for Standardization, triennial meeting, Harrogate, England.

June 10–13

First International Congress on Vacuum Techniques, Namur, Belgium.

June 11–14

National Society of Professional Engineers, Chase-Park Plaza, St. Louis, Mo.

June 12–14

American Institute of Industrial Engineers, national conference, Statler Hotel, Los Angeles, Calif.

(ASME Coming Events, see page 144)

president ASME, 1939 to 1942, has been named Engineer of the Year in Philadelphia. He is vice-president, engineering department, Philadelphia Electric Company, Philadelphia, Pa. DANA YOUNG, Mem. ASME, dean, college of engineering, Yale University, has been named Engineer of the Year in Connecticut.

New Appointments. VICTOR SAXL, Mem. ASME, at the request of the Government of Uruguay and by the appointment of the United Nations Technical Assistance Administration, has joined the Textile Industry Association of Uruguay. Mr. Saxl, a textile engineer in the woolen and worsted industries, will deal with such problems as the technical and administrative organization of the industry, the efficiency of machinery, the quality and availability of raw materials, and so on.

C. R. EARLE, Mem. ASME, has been named editor of *Power Engineering*. He succeeds A. W. KRAMER, Mem. ASME, who will be editor of *Atomics* and technical assistant to K. L. RICE, president of Technical Publishing Company, Barrington, Ill.

A. G. GRAY has been appointed editor of *Metal Progress*, and E. E. THUM has been advanced to the post of editor-in-chief. Dr. Gray had been a technical editor of *Steel*, and Mr. Thum had edited *Metal Progress* for 28 years.

J. M. GAVIN has been elected vice-president and a director of Arthur D. Little, Inc., Cambridge, Mass. General Gavin, prior to his retirement on March 31, 1958, had been Army Chief of Research and Development.

KARL E. SCHOENHERR, dean of the college of engineering at the University of Notre Dame, has been appointed technical director of the hydromechanics laboratory at the Navy's David Taylor Model Basin in Washington, D. C. He replaces F. H. TODD, who has returned to England as superintendent of the Ship Division, National Physical Laboratory, Teddington. Dr. Schoenherr is best known for his work in the frictional resistance of fluids along plane surfaces; published formula in 1932.

Campus Data. M. J. GOGLIA, Mem. ASME, has been named dean of the college of engineering, The University of Notre Dame. Dr. Goglia, a specialist in thermodynamics, has been serving as professor of mechanical engineering, Georgia Institute of Technology.

Doctor Durand Starts His Hundredth Year. William F. Durand was ASME President in 1925, upon his retirement as head of the Department of Mechanical Engineering at Stanford University. On March 5, 1958, he celebrated his ninety-ninth birthday. A year ago, shortly after his birthday, he suffered two mild strokes. Despite his age he has regained his strength and ability to move about. He regularly reads newspapers and technical magazines and watches television to keep in touch with what is going on outside his Brooklyn hotel, the Hotel Mohawk, 379 Washington Avenue, Brooklyn, N. Y. His ability to speak is somewhat hampered, but he can make his wishes and opinions known. Dr. Durand has nurses both day and night, who take good care of him, so he is quite happy. His son and daughter-in-law live only a block away, so he has frequent visits from them and their children and grandchildren. On his birthday Dr. Durand received a large number of telegrams, birthday cards and messages from his host of friends prominent in aviation and those who served on the ASME Council and administrative committees during the period he served as President and member of the Council.

Scott Turner, *left photo*, receives the 1958 Hoover Medal from Walker L. Cisler, *left*, Fellow ASME, chairman, Hoover Medal Board of Award. Mr. Turner, former director of the U. S. Bureau of Mines, is now a consulting mining engineer, New York, N. Y., and past-president of AIME. John R. Suman, *right photo*, receives the John Fritz Medal certificate for 1958 from L. K. Sillcox, *right*, past-president, Hon. Mem. ASME, and chairman, John Fritz Medal Board of Award. Mr. Suman, a consulting engineer, Houston, Texas, is a past-president of AIME. The awards, jointly sponsored by ASCE, AIME, ASME, and AIEE, were formally presented at the AIME Annual meeting banquet in New York, N. Y.

Dr. W. F. Durand shown in his most recent photo

Hughes Reveals Automated Machine-Tool Line, Claims . . .

Automation Will Place U. S. Ahead in Missile Race

IMPORTANT new technological progress in factory automation will sharply accelerate the "crash" development programs in guided missiles the United States now has under way, officials of Hughes Aircraft Company's Products Group told the newsmen from both coasts and the middle west in Los Angeles, Calif., recently.

At a Hughes plant, adjoining the Los Angeles International Airport, more than 100 writers and editors saw what was described as "the nation's first all-electronically controlled line of machine tools," operated from tapes and controlled by transistorized digital computers.

The line is now producing vital parts for the Hughes electronic armament control systems which are the "heart and brains" of American and Canadian Air Force all-weather interceptor planes patrolling the North American continent.

It was for these vitally necessary parts that Digitape controls were first conceived as a system by the Industrial Systems and Controls Division of Hughes Products to operate the machine-tool line automatically. Later, the support of Kearney and Trecker Corporation of Milwaukee was enlisted to develop and produce the machine tools necessary to achieve production.

Rollin M. Russell, Hughes' vice-president and chief executive of the Products Group, explained that the company's Digitape electronic controls had been linked with a milling machine, a drilling machine, and a boring machine. The result, he said, was to make available for the first time the economies of "Detroit-type" mass-production techniques in the area of small-lot production which now constitutes a major portion of the machining done by American industry.

"What we have here is the nucleus of the nation's first electronically automated factory," Mr. Russell declared. "The ability of the Digitape numerically-controlled line to shorten the time between engineering release and production of parts—from blueprint to hardware—and the ability to make engineering changes without sacrifice of production rates, will, we believe, be of substantial importance in crash development programs such as the United States now has under way in the guided missile race with Russia."

Store "Know-How" on Tape

"Much has been made of this nation's production know-how. We can now story know-how on a tape for use subsequent to the main production run or for communication to other defense manufacturers," he said.

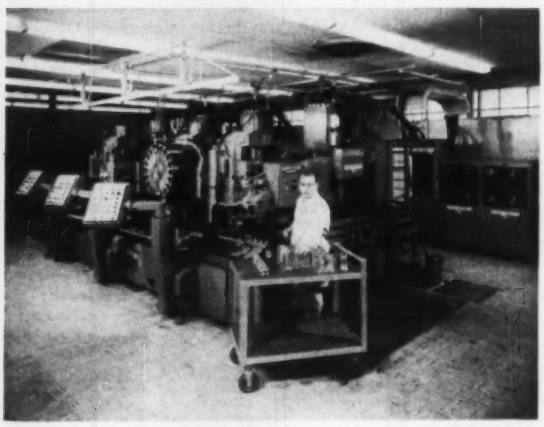
"Single machine tools have been electronically controlled in the past, but this is the first successful application of automatic electronic controls to a series of machine tools working on successive operations and, in fact, making a variety of parts at the same time," stated Mr. Russell. Changes in operations may be introduced or production may be started on new parts simply by changing punched tapes and without stopping the machines, he explained further.

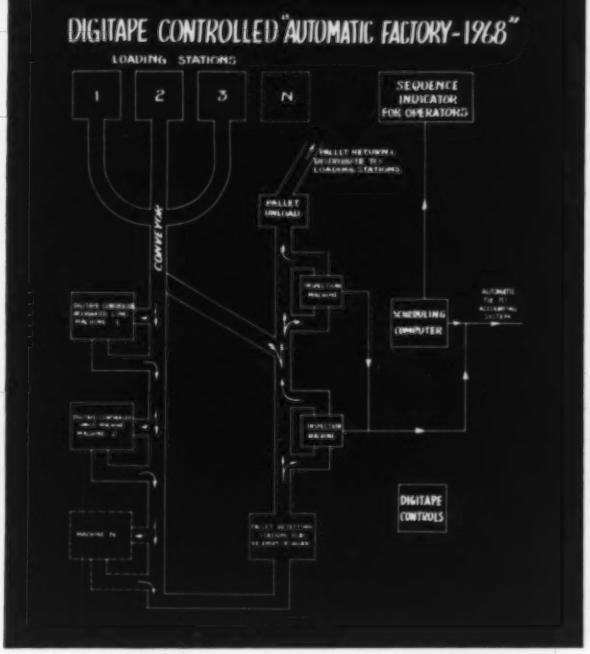
"It is Hughes' intention to make its controls systems available to all machine-tool manufacturers, and to manufacturers in other fields, such as industrial processing, where application can be equally effective," Mr. Russell announced. "In fact, after years of research and development, this marks our serious entry into the whole field of industrial systems and controls."

The integrated machine line with digi-

Secret of first all-electronically controlled machine-tool line, recently revealed by Hughes Aircraft Company. Heart of precise automation technique is this metal bar demonstrated by technician. The white stripe is actually a series of finely etched lines—500 to the inch—which small cylinder pickup head counts to position machine cutting edges so precisely that machined parts are accurate to within one thousandth of an inch. Principle of counting method is same as used by magnetic underwater mines which are activated by changing electromagnetic field.

Hughes Aircraft Company reveals nation's first all-electronically controlled machine-tool line. The line is operated by the Hughes Digitape electronic control system and governed by transistorized digital computers. These three machines automatically perform all steps in milling, drilling, and boring. Machines take their orders from punched tapes seen on reels in right background. The technician has only to feed a casting to the line and remove the finished part. Machines for prototype equipment in the Hughes system were designed and produced by Kearney and Trecker Corp., Milwaukee, Wis.





tape controls is constructed on the "building block" principle, marking the first time this principle has been successfully applied to electronically automated machine tools, Francis J. Trecker, Assoc-Mem. ASME, president of Kearney & Trecker, told the group.

"With the use of Digitape the actual production of a missile can be under way while, using normal methods, production would have reached only the prototype stage," Mr. Trecker said.

Both machines and controls are constructed to be fitted together as "blocks" in any desired number and arrangement to provide the greatest production savings for the type of parts to be machined. The line may be added to and rearranged from time to time and will still be capable of operating from a single tape for each type of part.

Easy Steps

A planning engineer first takes an ordinary blueprint of the part to be produced, and lists dimensions and the proper sequence of machining operations on a simplified planning sheet. A typist next transcribes the planning sheet data on punched tape, using a special keyboard. The completed tape is inserted in a tapereader in the controls, and the information fed into the computing "brain" of the system. Using the taped information, the controls give measuring, positioning, and cutting orders to machine tools on the automated line. In the prototype system demonstrated at the press conference the human operator needs only to place unmachined castings on the line and remove finished parts, but even this operation can easily be made automatic, it was pointed out.

"If every instrument would accomplish its own work, obeying or anticipating the will of others," said Aristotle, "if the shuttle would weave, or the plectrum touch the lyre, with no hand to guide them, then chief workers would not need assistants, nor masters slaves." We're getting closer, Mr. Aristotle.

Lights flash "thoughts" guiding automatic factory. Watching flicker of lights during operation of equipment, engineer monitors "thinking" of computer circuitry for all-electronically controlled line of machine tools. All information sent to milling, drilling, and boring machines by Digitape controls flows through this bank of contact relays and blinker lights. On this line three different types of parts are machined, all are run simultaneously. New type of automated factory sharply reduces time from blueprints to finished parts and makes possible sharp speed-up of defense program.

Advantages of System

Other outstanding characteristics are:

1 Because of its automatic nature, the line requires only one operator. Tapes can be punched by a typist after only a few hours of special instruction.

2 The required precision is built into the line and controls, thus less operator skill is needed.

3 "Set-up" operation is virtually eliminated, saving labor and time.

4 Tooling is, on the average, 50 per cent less, saving tool design and tool production time, thus shortening time between engineering drawing release and actual production.

5 Several different parts may be manufactured on the same line simultaneously. Changes can readily be made in the product, even during a production run; often by simply splicing a change into the tape.

6 Spare parts and re-orders may be run quickly and economically at any time subsequent to the main production with the same high quality and uniformity of the original. This means virtual elimination of costly inventories.

7 Simple dial adjustments may be made to correct variations in cutting edge dimensions.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Enrico Fermi Atomic Plant Trip Highlights Four-Day Intensive Technical Sessions at . . .

1958 ASME Semi-Annual Meeting in Detroit

A PROGRAM designed to keep them up to date technologically is expected to attract more than 2000 engineers to Detroit, Mich., June 15–19. The event is the Semi-Annual Meeting of The American Society of Mechanical Engineers.

According to the program announced by the Society, four days of intensive technical sessions will include topics in the power, safety, design, fuels, rubber and plastics, heat, production, and solar energy fields.

Attendees will consider such individual items as Russian and American systems of automation, work on commercial atomic energy power plants, gas turbines for automobiles, how to store solar energy for use when the sun doesn't shine, jet compression, and new steel alloys.

Additionally, there will be two panel discussions on the field of engineering itself. One is "Who Controls Your Future?" for the younger engineer, and the other will deal with the relationship between the consulting engineer and his client.

Those concerned particularly with commercial atomic energy will have an opportunity to inspect the new Enrico Fermi Atomic power plant. Visits to the plant areas and technical sections of major automobile producers will also be offered to ASME conference attendees.

SEMI-ANNUAL BANQUET

B **WEDNESDAY, JUNE 18** **7:00 p.m.**

Speaker: *K. T. Keller* (retired, Chrysler Corp.), Detroit, Mich.

Subject: **Fifty Years Association With Engineers**

PRESIDENT'S LUNCHEON

L **MONDAY, JUNE 16** **12:15 p.m.**

Address by: *James N. Landis*, President, ASME

CONSULTING ENGINEERING SESSION

CE **TUESDAY, JUNE 17** **2:30 p.m.**

Jointly with Consulting Engineers Association of Michigan

Panel Discussion

Relationship Between the Consulting Engineer and His Registered and Nonregistered Employees, *by representative of Michigan Society of Professional Engineers*

Relationship Between the Consultant and His Client, *by representative of Consulting Engineers Society of Michigan*

Relationship of the Consultant and the Technical Societies, *by an ASME representative*

FUELS SESSIONS

I **MONDAY, JUNE 16** **9:30 a.m.**

Jointly with Maintenance and Plant Engineering

Residual Fuels and Diesel Engine Cylinder Wear,[1] by *J. M. A. Van der Horst*, Van der Horst Corp. of America

Computer Reduces Man-Hours in Fuel Analysis Calculations,[1] by *W. H. Guppy* and *C. J. Wegert*, Commonwealth Edison Co.

II **MONDAY, JUNE 16** **2:30 p.m.**

Burner Maintenance, by *R. D. Reed*, John Zink Co. (Paper No. 58—SA-56)

A Modern Safeguard for Automatic Boilers, by *P. E. Buday*, Cleaver-Brooks Co. (Paper No. 58-SA-50)

Simplification of Gas-Fired Heat Processes,[1] by *R. C. Le May*, Selas Corp. of America

III **WEDNESDAY, JUNE 18** **9:30 a.m.**

Jointly with Power

See Power IV

GAS TURBINE POWER SESSIONS

I **MONDAY, JUNE 16** **9:30 a.m.**

Determination of Erosion Rates in Turbojet-Fuel Nozzles by Radiochemical Techniques, by *H. R. Hazard*, Battelle Memorial Inst.; *R. W. Tate*, Delavan Manufacturing Co.; and *Peter Gluck*, Battelle Memorial Inst. (Paper No. 58—SA-55)

Stage Performance and Radial Matching of Axial Compressor-Blade Rows, by *Jeffrey Watkins*, Solar Aircraft Co. (Paper No. 58—SA-21)

The Measured and Visualized Behavior of Rotating Stall in an Axial-Flow Compressor and in a Two-Dimensional Cascade, by *Gino Sovran*, GM Research Staff. (Paper No. 58—SA-20)

II **MONDAY, JUNE 16** **2:30 p.m.**

Design and Development of a Supercharger for a Pressure-Fired Boiler, by *R. C. Reisweber*, Elliott Co. (Div. of Carrier Corp.); *J. W. Glessner*, Solar Aircraft Co.; and *J. R. Shields*, Elliott Co. (Div. of Carrier Corp.) (Paper No. 58—SA-25)

Some Thoughts About the Development of Auto-

[1] Paper not available—see box on page 131.

Registration Schedule

Sunday, June 15	2:00 p.m. to 5:00 p.m.
Monday, June 16	8:00 a.m. to 3:00 p.m.
Tuesday, June 17	8:00 a.m. to 3:00 p.m.
Wednesday, June 18	8:00 a.m. to 3:00 p.m.
Thursday, June 19	8:00 a.m. to 3:00 p.m.

motive Gas-Turbine Units, by *A. T. Bowden* and *W. Hryniszak*, C. A. Parsons & Co., Ltd., Newcastle-upon-Tyne, England. (Paper No. 58—SA-26)

HEAT TRANSFER SESSIONS

I WEDNESDAY, JUNE 18 9:30 a.m.

Transient Temperature Distribution and Thermal Stresses in a Hypersonic, Unsymmetrical Wing Structure at Angles of Attack,[1] by *Shih-Yuan Chen*, Republic Aviation Corp.

Transient Response of Heated Air in an Enclosure With Heat Losses, by *W. A. Wolfe*, U of British Columbia, Vancouver, B. C., Canada. (Paper No. 58—SA-3)

A Boundary-Layer Treatment of Laminar Film Condensation, by *E. M. Sparrow, J. L. Gregg*, and *J. W. Crowley*, NACA. (Paper No. 58—SA-2)

II WEDNESDAY, JUNE 18 2:30 p.m.

The Thermal Conductivity of Aluminum-Honeycomb Material Near Room Temperature, by *J. T. Gier* and *R. V. Dunkle*, U of California, and *J. T. Bevans*, Shell Development Co. (Paper No. 58—SA-1)

The Calculation of Forging Cooling Rates, by *D. P. Timo* and *R. M. Goldhoff*, Gen Elec Co. (Paper No. 58—SA-4)

Regenerative Heat Exchanger With Heat-Loss Consideration, by *E. K. Dabora*, U of Michigan. (Paper No. 58—SA-29)

III THURSDAY, JUNE 19 9:30 a.m.

Heat-Transfer Charts for Time-Variable Boundary Conditions, Part 1, Semi-Infinite Solid, by *T. J. Mirsepassi*, Aerojet-General Corp. (Paper No. 58—SA-7)

Modified Boundary-Layer-Type Solution for Free-Convection Flow in Vertical-Closed Tube With Arbitrarily Distributed Internal-Heat Source and Wall Temperature, by *F. G. Hammitt*, U of Michigan. (Paper No. 58-SA-30)

Leakage and Elastic Characteristics of Compressed Asbestos-Sheet Packing, by *J. J. Whalen*, Johns-Manville Sales Corp. (Paper No. 58—SA-28)

IV THURSDAY, JUNE 19 2:30 p.m.

Wave Theory of Heat Transfer in Film Boiling, by *Yan-Po Chang*, U of California (Paper No. 58—SA-19)

Dynamic Response of Heat Exchangers Having Internal-Heat Sources, Part 3, by *V. S. Arpaci*, M. I. T., and *J. A. Clark*, U of Michigan. (Paper No. 58—SA-39)

An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flows,[1] by *J. E. Lay*, Michigan State U

HIGH-TEMPERATURE STEAM-GENERATION SESSION

HTSG TUESDAY, JUNE 17 2:30 p.m.

Jointly with Power, ASTM, and Metals Engineering

See Power III

HYDRAULIC SESSIONS

I MONDAY, JUNE 16 9:30 a.m.

Friction Factors for Turbulent Flow in Curved Pipes, by *Hidesato Itô*, Tôhoku U, Sendai, Japan. (Paper No. 58—SA-14)

Review of Some Recent Advances in the Understanding of Transition From Laminar to Turbulent Shear Flows,[1,2] by *M. Morkovin*, Johns Hopkins U

Studies of Jet Compression, Part 1. Apparatus and Methods. Results With Air at Room Temperature, by *H. J. Hoge, Suzanne S. Eichacker*, and *D. L. Fiske*, Quartermaster R&E Center. (Paper No. 58—SA-13)

[1] Paper not available—see box on this page.
[2] Not presented orally.

II MONDAY, JUNE 16 2:30 p.m.

Prediction of Chocking Flow in Centrifugal Impellers, by *F. J. Wiesner* and *Harold Lown*, Carrier Corp. (Paper No. 58—SA-15)

On the Necessity of Unsteady Flow in Fluid Machines,[1] by *R. C. Dean, Jr.*, Ingersoll-Rand Co.

III TUESDAY, JUNE 17 9:30 a.m.

Hydraulics in a Progress-Through Machine,[1] by *A. B. Riddiford, Jr.*, John S. Barnes Corp.

Technical Considerations in the Application of Hydraulic-Torque Converters,[1] by *H. J. Wirry*, Twin Disc Clutch Co.

INSTRUMENTS AND REGULATORS SESSIONS

I WEDNESDAY, JUNE 18 9:30 a.m.

Concerning Subharmonic Oscillations Which May Exist in Nonlinear Systems Having Odd Restoring Forces, by *C. A. Ludeke*, U of Cincinnati; Gen Elec Co., and *William Pong*, Baldwin Piano Co.

An Analytic Frequency-Response Solution for a Higher Order Servomechanism With a Nonlinear Control Element, by *A. M. Hopkin*, U of California, and *Katsuhiko Ogata*, U of Minnesota. (Paper No. 58—SA-35)

Antifriction-Instrument Bearing Torque Testing and the Resistance to Motion of Such Bearings, by *A. B. Asch*, Asch Equipment Co. (Paper No. 58—SA-34)

II WEDNESDAY, JUNE 18 2:30 p.m.

Jointly with Process Industries

See Process Industries III

JUNIOR SESSION

J TUESDAY, JUNE 17 2:30 p.m.

The Young Engineer and His Future

Who Controls Your Future? by *T. J. Feaheny, Jr.*, Ford Motor Co., *C. M. Ladd*, Atomic Power Development Associates, Inc., and *R. I. Walker, Jr.*, Allis-Chalmers Manufacturing Co. (Paper No. 58—SA-51)

LUBRICATION SESSIONS

I WEDNESDAY, JUNE 18 9:30 a.m.

Gas Bearings

Gas-Bearing-Application Problems in Aircraft-Accessory Equipment,[1] by *C. R. Adams*, Boeing Airplane Co.

The Load Capacity and Attitude Angle of Gas-Lubricated Journal Bearings,[1] by *Manfred Wildmann*, Autonetics, Division of North American Aviation, Inc.

On the Stability of Externally Pressurized Gas Bearings,[1] by *Lazar Licht*, The Franklin Inst.

Investigation of Hydrostatic Journal Bearings With Helium and Nitrogen as Lubricants,[1] by *Beno Sternlicht* and *R. E. Elwell*, Gen Elec Co.

II WEDNESDAY, JUNE 18 2:30 p.m.

Lubricants and Lubrication Digest—1957 Literature

Ball and Roller Bearings and Gear Lubrication, *H. Apkarian* and *P. Lewis*, Gen. Elec. Co., and *P. Baker*, GM Corp.

Fluid Films: Journal and Thrust Bearings, *H. Apkarian* and *G. R. Fox*, Gen Elec Co.

Boundary Lubrication, Friction, and Wear, *Morton Antler*, Ethyl Corp.

Metalworking Lubrication, *N. H. G. Daniels*, Shell Development Co.

Automotive Lubricants and Properties of Lubricants, *H. A. Hartung*, Atlantic Refining Co.

Orders for ASME Technical Papers

ONLY copies of *numbered* ASME papers will be available. Please order only by paper *number*; otherwise the order will be returned. Order your copies of *numbered* papers by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Production problems may delay the availability of some numbered papers. However, orders will be held for such papers only until May 29, 1958.

Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $2 to members; $4 to nonmembers.

Copies of unnumbered papers, listed in this program, *are not available* in advance of the meeting because the review of these manuscripts had not been completed when the program went to press.

The August, 1958, issue of MECHANICAL ENGINEERING will contain a complete listing of all available papers.

III THURSDAY, JUNE 19 9:30 a.m.

A Variational Approach to Lubrication Problems and the Solution of the Finite Journal Bearing,[1] by *D. F. Hays*, GM Research Staff

The Influence of Journal Geometry on Journal-Bearing Performance,[1] by *A. O. De Hart*, GM Research Staff

LW THURSDAY, JUNE 19 2:30 p.m.

Lubrication Workshop

The Influence of Journal Bearings on Rotor Vibration, *A. C. Hagg*, Westinghouse Elec. Corp.

Practical Experiences With Design of Sleeve Bearings, *A. Egli*, Ford Motor Co.

Some Instrumentation and Test Results on Journal and Thrust Bearings, *R. L. Ward*, U. S. Naval Engineering Experimental Station

An Application of Hydrostatic Lubrication to a Grease Lubricated Roll-Neck Bearing, *N. Sindlinger*, The Franklin Inst.

MACHINE DESIGN SESSIONS

I MONDAY, JUNE 16 9:30 a.m.

Analytical Design of an Ackerman Steerage Linkage, by *W. A. Wolfe*, U of British Columbia, Vancouver, B. C., Canada. (Paper No. 58—SA-31)

Dynamic Loading on Spur-Gear Teeth, by *A. Y. Attia*, Ein Shams U, Abbassia, Cairo, Egypt. (Paper No. 58—SA-32)

Effect of Shot-Peening on Fatigue Strength, by *R. P. Felgar*, Gen Elec Co. (Paper No. 58—SA-46)

II MONDAY, JUNE 16 2:30 p.m.

Structural Error Analysis in Plane Kinematic

Caltech Alumni Meeting

THE alumni of California Institute of Technology will hold a dinner meeting at 6:00 p.m., on Tuesday, June 17, 1958, at the Ford Motor Company Central Office Building, Dearborn, Mich. The principal speaker will be Lee A. DuBridge, president of California Institute of Technology. The subject of Dr. DuBridge's talk will be on the design of the Explorer satellite. James N. Landis, ASME President, will join the Caltech Dinner group as coffee speaker. Alumni and families are invited. The reservations should be sent directly to Mr. Jay C. Taylor, Patent Department, Engineering Division, Chrysler Corporation, P. O. Box 1118, Detroit 31, Mich.

In conjunction with this alumni meeting, a limited number of ASME members will be able to hear Dr. DuBridge's address at 8:00 p.m. A film on the Explorer design will be part of the presentation. Reservations should be made through Mr. Taylor. Transportation costs will be $1 each.

Synthesis, by *Ferdinand Freudenstein*, Columbia U. (Paper No. 58—SA-12)

The Design of Linkages to Generate Functions of Two Variables,[1] by *C. W. Allen*, Gen Elec Co

How to Replace Gears by Mechanisms (Linkages), by *Kurt Hain* and *Gerhard Marx*, Institut für Landtechnische Grundlagenforschung der Forschungsanstalt für Landwirtschaft, Braunschweig, Bundesallee, Germany (To be presented by *T. P. Goodman*, M.I.T.). (Paper No. 58—SA-33)

III TUESDAY, JUNE 17 9:30 a.m.

Design of Helical Springs for Minimum Weight, Volume, and Length, by *R. T. Hinkle* and *I. E. Morse*, Michigan State U. (Paper No. 58—SA-9)

Helical Springs of Hollow, Circular Cross Section, by *C. W. Bert*, Battelle Memorial Inst. (Paper No. 58—SA-18)

Stress and Strain in Spinning Paraboloid Dishes, by *M. J. Cohen*, Northampton College of Advanced Technology, London, England. (Paper No. 58—SA-8)

IV TUESDAY, JUNE 17 2:30 p.m.

Performance of Electromagnetic Multiple-Disk Clutches and the Influence of Various Disk-Types Upon the Clutch Characteristics,[1] by *Claus Nitsche*, McCauley Industrial Co.

The Pin, by *M. J. Schilhansl*, Brown U (Paper No. 58—SA-23)

Trip-Free Mechanisms,[1] by *H. L. Peek*, Allis-Chalmers Manufacturing Co.

MAINTENANCE AND PLANT ENGINEERING

SESSIONS

I MONDAY, JUNE 16 9:30 a.m.

Jointly with Fuels

See Fuels I

[1] Paper not available—see box on page 131.

II MONDAY, JUNE 16 2:30 p.m.

Training Maintenance and Engineering Personnel,[1] by *R. G. Smith*, Dow Chemical Co.

Role of Petroleum-Base Rust and Corrosion Preventives in Plant Maintenance,[1] by *R. A. Fitch*, Gulf R&D Co.

MANAGEMENT

SESSIONS

I TUESDAY, JUNE 17 9:30 a.m.

Jointly with Production Engineering and AIIE

See Production Engineering II

II TUESDAY, JUNE 17 2:30 p.m.

Jointly with Production Engineering and Process Industries

Effective Handling of Engineering Personnel

Engineer Retention, by *J. D. Staley*, American Management Association. (Paper No. 58—SA-45)

Concepts of Job Assignment in the Project-Type Engineering Department, by *C. H. Crosby*, Aerojet-General Corp. (Paper No. 58—SA-47)

Where Do Research Scientists Spend Their Time? by *G. A. Peters*, Psychological Research Associates, Inc., and *Max Lees*, Durban, Natal, South Africa. (Paper No. 58—SA-37)

III WEDNESDAY, JUNE 18 9:30 a.m.

Jointly with Production Engineering, Materials Handling, and Process Industries

Effective Handling of Engineering Data

The Orderly and Economic Handling of Engineering Data,[1] by *T. W. Schwartz*, E. I. du Pont de Nemours & Co., Inc.

A Blueprint for the Storage and Retrieving of Coded Mechanical-Engineering Data, by *Edna G. Gilbo*, Chicago, Ill. (Paper No. 58—SA-6)

Technical Data on Border-Punched Cards,[1] by *Gunther Cohn*, The Franklin Inst.

L WEDNESDAY, JUNE 18 12:15 p.m.

Management—American Institute of Industrial Engineers Luncheon and Towne Lecture

Presider: *Robert G. Hess*, Walworth Co.

IV WEDNESDAY, JUNE 18 2:30 p.m.

Jointly with Production Engineering and AIIE

See Production Engineering V

V THURSDAY, JUNE 19 2:30 p.m.

Jointly with Materials Handling

See Materials Handling III

MATERIALS HANDLING

SESSIONS

I WEDNESDAY, JUNE 18 9:30 a.m.

Jointly with Management, Production Engineering, and Process Industries

See Management III

II THURSDAY, JUNE 19 9:30 a.m.

New Flexibility in Bulk Materials Handling,[1] by *I. S. Lyman*, Bakelite Co., Div. of Union Carbide Corp.

Bulk-Materials Flow,[1] by *W. R. Runo*, Richardson Scale Co.

III THURSDAY, JUNE 19 2:30 p.m.

Jointly with Management

Organized Storage—Clue to Warehouse Mechanization,[1] by *E. E. Moon*, Mathews Conveyor Co.

Industrial Applications of Pneumatic Shelters,[1] by *C. B. Putney* and *M. L. Croom*, E. I. du Pont de Nemours & Co., Inc.

METALS ENGINEERING

SESSIONS

I TUESDAY, JUNE 17 9:30 a.m.

Presider: *Milton Lebow*, Wayne State U

Speaker: *Raymond L. Mattson*, General Motors Corp.

Subject: **Residual Stresses, Cold Working, and Fatigue**

II TUESDAY, JUNE 17 2:30 p.m.

Jointly with Power, ASTM, and High Temperature Steam Generation

See Power III

NUCLEAR ENGINEERING

SESSIONS

I WEDNESDAY, JUNE 18 2:30 p.m.

Operating Experiences at the Ford Nuclear Reactor,[1] by *H. J. Gomberg* and *J. L. Shapiro*, U of Michigan

Technical Design of the Dresden Nuclear Power Station,[1] by *L. E. Foster*, Gen Elec Co.

ASME National Nominations

THE 1958 Nominating Committee is to meet for two days, June 16–17, 1958, at the Statler-Hilton Hotel in Detroit, Mich., where the Semi-Annual Meeting will be held. Hearings will be held so that members may speak in behalf of their candidates for the office of President, Regional Vice-Presidents, and Directors any time between the hours of 10:00 a.m. to 12:00 noon; and from 2:00 p.m. to 5:00 p.m. (or, if necessary, from 8:00 p.m. to 9:30 p.m.) on Monday, June 16, and on Tuesday, June 17, from 9:00 a.m. to 12:00 noon and, if necessary, from 2:00 p.m. to 4:00 p.m. Following the close of business of the 1958 Nominating Committee there will be held an Organization Meeting of the 1959 Committee presided over by A. B. Heiberg, chairman of the 1958 Committee. This meeting will take place on Tuesday afternoon or evening, June 17, following the Business Meeting of the 1958 Committee or, if necessary to extend the Business Meeting through Tuesday evening, the Organization Meeting will be held at 9:30 a.m. Wednesday, June 18.

The Operation of Centrifugal Pumps in Pressurized Water Reactor Plants,[1] by *L. F. Emerson*, Westinghouse Elec Corp.

II THURSDAY, JUNE 19 9:30 a.m.

Some Notes on the Strength of the Enrico Fermi Reactor Vessel Structure,[1] by *F. R. Beyer*, Atomic Power Development Associates, Inc.

Environmental Studies for the Enrico Fermi Atomic Power Plant,[1] by *J. G. Feldes*, Power Reactor Development Co., and *G. H. Whipple*, U of Michigan; Atomic Power Development Associates, Inc.

POWER SESSIONS

I MONDAY, JUNE 16 2:30 p.m.

Electrostatic Shaft Voltage on Steam-Turbine Rotors, by *J. M. Gruber* and *E. F. Hansen*, Gen Elec Co. (Paper No. 58—SA-5)

The Control System of a 225,000-Kw Double Automatic Extraction Steam Turbine and Related Reducing Stations, by *M. A. Eggenberger* and *P. G. Ipsen*, Gen Elec Co. (Paper No. 58—SA-36)

Flow Modulator for K-F Direct Contact Regenerative Heater System, by *H. A. Kuljian*, Kuljian Corp., and *H. S. C. Chen*, Drexel Inst of Tech. (Paper No. 58—SA-48)

II TUESDAY, JUNE 17 9:30 a.m.

A Review of Engineering Considerations for the River Rouge Power Plant, by *G. A. Porter* and *W. L. Wingert*, Detroit Edison Co. (Paper No. 58—SA-10)

Design of 321-MW Cross-Compound Steam Turbine River Rouge Unit No. 3, by *C. D. Wilson*, Allis-Chalmers Manufacturing Co. (Paper No. 58—SA-22)

Features of a Full-Scale, Low-Pressure Turbine-Development Facility,[1] by *J. E. Downs* and *K. C. Cotton*, Gen Elec Co.

III TUESDAY, JUNE 17 2:30 p.m.

Jointly with ASTM, High-Temperature Steam Generation, and Metals Engineering

Symposium: Alloy Superheater and Reheater Tubing Operating at 1000 F and Above

P. M. Brister, The Babcock & Wilcox Co.

J. L. Menson, Combustion Engineering, Inc.

Claude L. Clark, Timken Roller Bearing Co.

H. M. Soldan, Public Service Electric & Gas Co.

H. H. Hemenway, Foster Wheeler Corp.

IV WEDNESDAY, JUNE 18 9:30 a.m.

Jointly with Fuels

Operating Results of an Experimental Supercritical Steam Generator, by *E. L. Daman, Henry Phillips, John Vatl*, and *Sulin Ling*, Foster Wheeler Corp. (Paper No. 58—SA-17)

Availability Balance of Steam-Power Plants, by *C. A. Meyer, G. J. Silvestri*, and *J. A. Martin, Jr.*, Westinghouse Elec Corp. (Paper No. 58—SA-16)

Pulverized-Coal Transport Through Pipes, by *R. C. Patterson*, Combustion Engineering, Inc. (Paper No. 58—SA-24)

PROCESS INDUSTRIES SESSIONS

I TUESDAY, JUNE 17 2:30 p.m.

Jointly with Management and Production Engineering

See Management II

II WEDNESDAY, JUNE 18 9:30 a.m.

Jointly with Management, Production Engineering, and Materials Handing

See Management III

[1] Paper not available—see box on page 131.

III WEDNESDAY, JUNE 18 2:30 p.m.

Jointly with Instruments and Regulators

An Example of System Design by Logic,[1] by *E. S. Taylor*, E. I. du Pont de Nemours & Co., Inc.

Mathematical Relationships for Computer-Control Systems,[1] by *T. M. Stout*, Thompson-Ramo-Wooldridge Products Co.

PRODUCTION ENGINEERING SESSIONS

I MONDAY, JUNE 16 9:30 a.m.

Metal Cutting

The Effect of a Lead Additive on the Machinability of Alloy Steels, by *Norman Zlatin* and *J. V. Gould*, Metcut Research Associates Inc. (Paper No. 58—SA-53)

Controlled-Contact Cutting Tools, by *K. J. Trigger* and *B. T. Chao*, U of Illinois. (Paper No. 58—SA-42)

II TUESDAY, JUNE 17 9:30 a.m.

Jointly with AIIE and Management

Automation

A Look at Russian Automation and Technical Developments, by *N. L. Bean*, Ford Motor Co. (Paper No. 58—SA-11)

Automation Progress in the United States, by *L. D. Miller, Automation*. (Paper No. 58—SA-52)

L TUESDAY, JUNE 17 12:15 p.m.

Production Engineering Luncheon

Presider: *Ford H. McBerty*, E. I. du Pont de Nemours & Co., Inc.

Introduction of Speaker: *Harvey E. Bumgardner*, The Detroit Edison Co.

Speaker: *James C. Zeder*, Chrysler Corp.

Subject: **Some Business Considerations in the Outlook for Mechanical Engineering**

III TUESDAY, JUNE 17 2:30 p.m.

Jointly with Management and Process Industries

See Management II

IV WEDNESDAY, JUNE 18 9:30 a.m.

Jointly with Management, Materials Handling, and Process Industries

See Management III

V WEDNESDAY, JUNE 18 2:30 p.m.

Jointly with AIIE and Management

Statistics in Production Engineering

Minimizing Waste in Strip Cutting,[1] by *G. G. O'Brien*, Touche, Niven, Bailey & Smart

VI THURSDAY, JUNE 19 9:30 a.m.

Factors Influencing the Performance of Grinding Wheels, by *E. J. Krabacher*, Cincinnati Milling Machine Co. (Paper No. 58—SA-40)

A Study of the Effects of Tool-Flank Wear on Tool-Chip Interface Temperature, by *D. R. Olberts*, Allis-Chalmers Manufacturing Co. (Paper No. 58—SA-41)

VII THURSDAY, JUNE 19 2:30 p.m.

Beryllium Machining Characteristics, by *D. R. Walker*, Avco Manufacturing Corp. (Paper No. 58—SA-43)

Grinding a Titanium Alloy With Coated Abrasives, by *D. E. Cadwell, H. L. Weisbecker*, and *W. J. McDonald*, Minnesota Mining & Manufacturing Co. (Paper No. 58—SA-44)

RUBBER AND PLASTICS SESSIONS

I TUESDAY, JUNE 17 9:30 a.m.

Expandable Polystyrene—Applications and Fabrication,[1] by *D. F. Redman*, The Dow Chemical Co.

The Mechanical Properties of Low-Density Plastic Foams as Energy Absorbers,[1] by *E. R. Dye* and *M. D. Smith*, Cornell Aeronautical Lab., Inc.

Rigid Foams,[1] by *H. A. Pace*, Goodyear Tire & Rubber Co.

Rigid Plastic Foams,[1] by *M. H. Nickerson*, DeBell & Richardson, Inc.

Development of Sandwich-Construction Refrigerator Cabinets,[1] by *F. R. Marshall*, Westinghouse Elec Corp.

II TUESDAY, JUNE 17 2:30 p.m.

Designing With Rigid Polyvinyl Chloride,[1] by *J. A. Rolls* and *Martin Batiuk*, B. F. Goodrich Chemical Co.

New Developments in Silicone Rubber,[1] by *G. M. Konkle*, Dow Corning Corp.

Solid Urethanes—A New Method of Construction,[1] by *K. A. Pigott*, Mobay Chemical Co.

Engineering Properties and Applications of Polypropylene,[1] by *E. W. Cronin*, Hercules Powder Co.

Summary of Papers Presented at Rubber and Plastics, Sessions 1 and 2, by *F. J. Wehmer*, Technical Sessions Chairman

SAFETY SESSION

I MONDAY, JUNE 16 9:30 a.m.

The Hazard Family,[1] by *J. R. Stone*, General Motors Corp.

Planning Safety Into Automation,[1] by *Thomas Seavey*, GM Corp. (to be presented by *William C. Killen*, GM Corp.)

STUDENT MEMBER COMPETITION

1958 OLD GUARD PRIZE

I WEDNESDAY, JUNE 18 9:30 a.m.

The names of six winners from Regional Student Conferences will appear in the final program after selection has been determined at conclusion of the last student conference on May 3.

II WEDNESDAY, JUNE 18 2:30 p.m.

The names of six additional winners from Regional Student Conferences will appear in the final program after selection has been determined at conclusion of the last student conference, May 3.

Official Notice: Business Meeting

THE Semi-Annual Business Meeting of the members of The American Society of Mechanical Engineers will be held on Tuesday, June 17, 4:45 p.m., Statler-Hilton Hotel, Detroit, Michigan, as part of the Semi-Annual Meeting of the Society.

The program is planned to include the announcements of the location of the 1959 Semi-Annual Meeting and election of the Nominating Committee for 1959.

This Business Meeting of the members provides an opportunity for a free discussion of Society policies and procedures, and all members are urged to attend.

INSPECTION TRIPS

I TUESDAY, JUNE 17 1:30 p.m.

General Motors Technical Center Architectural Summary

On its architectural merits alone, General Motors Technical Center has created international interest and has been cited as a prototype of the industrial environment of the future.

Before its completion two of its functionally modern buildings, Engineering Staff and Central Restaurant, won top awards of the American Institute of Architects.

Technical Center occupies the central 330 acres of more than 900 owned by General Motors at Warren, Mich., north of Detroit. It includes five central staff organizations—Research, Engineering, Process Development, Styling, and Technical Center Service Section.

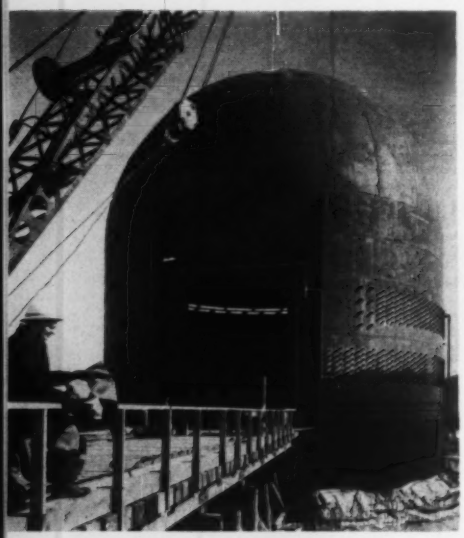
There are 25 buildings ranging from gatehouses to large laboratory, office, and shop buildings.

II WEDNESDAY, JUNE 18 9:00 a.m.

Ford Motor Company—Rouge Plant

The Ford Motor Company's Rouge plant with its huge manufacturing area and the famous Ford Rotunda is located in a two-sq-mile industrial area which includes blast furnaces, steel mill, foundries, pressed-steel operations, engine-producing facilities, final assembly, and other operations. Rouge buildings have more than 15,500,000 sq ft of floor space and the area contains 110 miles of railroad line. Automobiles manufactured here are distributed through the United States and abroad.

The ASME visit will consist of a tour through the final assembly line, a drive through the Rouge plant grounds, and a tour of the Rotunda.



Symbol of the atomic age, the all-steel reactor containment building on the Enrico Fermi Power Plant site near Monroe, Mich., new landmark on Lake Erie

III WEDNESDAY, JUNE 18 1:30 p.m.

Detroit Edison's River Rouge Power Plant

The River Rouge power plant on the Detroit River is one of the most modern in the world and the largest electric power station in the Detroit Edison system. Two turbine-generators, each with a capacity of 260,000 kw of electric power are now on the line, and the third machine—a giant of 320,000 kw of capacity—will be in operation this summer.

The boilers for the first two units are producing one and three-quarters million lb of steam an hour at a pressure of 2000 lb per sq in. and a temperature of 1050 F–1000 F reheat. The number three boiler will produce 2 million lb of steam per hr at 2400 psi, and temperature of 1050 F–1000 F reheat.

When this plant is in full operation the Detroit Edison power system will have a capacity of nearly $3^1/_2$ million kw.

IV THURSDAY, JUNE 19 9:00 a.m.

The Chrysler Mound Road V-8 Engine Plant

The Chrysler Mound Road V-8 engine plant is one of the most modern automated plants in the world. It employs 3000 employees and produces 150 Plymouth Hi-Fire V-8 engines an hour or $2^1/_2$ per minute. The plant contains a most elaborate conveyer system consisting of:

1 22 conveyers in underground chip-drag system with total length of 5200 ft and covering 200,000 sq ft of the plant.

2 25 conveyers in overhead monorails system with total length of 17,000 sq ft.

3 4000 ft of crankshaft automation—conveyers which move crankshafts automatically from one machine operation to the next.

The dust-collection system employs 61 aerodyne dry-type dust collectors, each of which filter 10,000 cu ft per minute. The coolant system, consisting of 11 systems with 3900 ft of trench, pumps 12,050 gal of coolant per minute. The wiring used in the plant amounts to 107 million ft or 20,500 miles.

High Lights of the 1958 Semi-Annual Meeting

Sunday, June 15

6:00 p.m. "Early Bird" Party

Monday, June 16

12:15 p.m. President's Luncheon

6:00 p.m. Starlight Cruise

Tuesday, June 17

12:15 p.m. Production Engineering Luncheon

4:45 p.m. Business Meeting

Wednesday, June 18

12:15 p.m. Management—American Institute of Industrial Engineers Luncheon and Towne Lecture

7:00 p.m. Banquet

V THURSDAY, JUNE 19 1:30 p.m.

Enrico Fermi Atomic Power Plant

The Enrico Fermi atomic power plant, now under construction on the shore of Lake Erie near Monroe, is Michigan's first atomic power plant. It is the only breeder-reactor power plant in the world being built with private funds in co-operation with the AEC, who are also contributing certain supporting research in their test facilities. The project is a good example of co-operative effort by a group of electric companies, manufacturing, and engineering firms with the AEC reactor program.

The reactor part of the plant is being built by the Power Reactor Development Company, who also will own and operate the reactor when completed in 1960. Atomic Power Development Associates, Inc., under contract with PRDC is responsible for the development and conceptional design of the nuclear portion of the reactor. The Detroit Edison Company will build, own, and operate a conventional electric-generating section adjacent to the reactor plant, and will purchase steam from PRDC to operate a 156,000-kw turbine-generator.

The reactor vessel is now being installed inside the 120-ft steel containment building on the site with piping, shielding, and other equipment also going into place. The structural work on the boilerhouse, turbine room, and other buildings is proceeding at the same time and gives the visitor an impressive view of America's progress in the peacetime use of atomic energy.

SPECIAL EVENT

MONDAY, JUNE 16 6:00 p.m.

Starlight Cruise of Detroit River and Lake Front

A buffet dinner, starting at 6:30 p.m., will consist of Roumell's baked champagne ham, fried and jointed spring chicken, Italian meat balls in tomato sauce, Boston baked beans, assorted molded salad, assorted relishes, assorted rolls and breads, assorted petit French pastries, coffee, tea, and milk.

Dutch treat bars will be provided for beer and mixed drinks.

At 7:00 p.m. the Bob-lo flagship will start on the 40-mile cruise down river to a point below the Great Lakes Steel Corporation, then across the river up to the Canadian side, past Belle Isle to Windmill Point, returning down the Detroit River.

Music by a popular orchestra will be provided for dancing on shipboard.

The cruise will end at 10:00 p.m.

WOMEN'S PROGRAM

SUNDAY, JUNE 15

2:00 p.m. Registration

6:00 p.m. "Early Bird" Party

MONDAY, JUNE 16

8:00 a.m. Registration

9:00 a.m. Coffee Hour

12:15 p.m. President's Luncheon

1:00 p.m. Bus tour of Detroit. Includes Civic Center Expressways, Boulevard Area, Wayne State University, and Art Center. Tour will terminate at the Rackham Building.

3:00 p.m. Tea in the Rackham Building

6:00 p.m. Starlight Cruise

TUESDAY, JUNE 17

8:30 a.m. Coffee Hour

10:00 a.m. Bus tour of the shores of Lake St. Clair and Grosse Pointe terminating at General Motors Technical Center. Tour of General Motors Technical Center. Bus trip to Eastland Shopping Center.

1:15 p.m. Luncheon and fashion show at the Anchor Room of the J. L. Hudson Company. Shop in Eastland Center after luncheon.

WEDNESDAY, JUNE 18

9:30 a.m. Bus trip to Ford Motor's Dearborn plant and tour either the Ford plant or the Ford Museum

1:15 p.m. Luncheon in main dining room of Dearborn Inn.

WEDNESDAY, JUNE 18

2:30 p.m. Tour of the Ford Museum or carriage trip through Greenfield Village

7:00 p.m. Banquet

THURSDAY, JUNE 19

9:00 a.m. Coffee Hour

ASME Conference to Discuss Materials-Handling Problems in Atomic-Space Age

MATERIALS-HANDLING problems in the atomic and space age will be among the diverse topics featured during the ASME Materials Handling Conference to be held at the Public Auditorium, Cleveland, Ohio, June 9–12, 1958.

The four-day conference is sponsored by the Materials Handling Division of The American Society of Mechanical Engineers and will be held concurrently with the National Materials Handling Exposition. The technical sessions will be devoted to scientific management in materials handling, new developments in materials handling, design and development of special equipment, and materials handling in the atomic and space age. Sessions will commence at 9:30 a.m. each day.

More than 100 basic types of mechanical-handling equipment will be displayed in the National Materials Handling Exposition, which is produced by Clapp & Poliak, Inc., New York exposition management firm. The exhibit, comprehensive in scope, including some 6000 pieces of equipment displayed by more than 200 companies, will be open Monday through Thursday from 12:00 noon to 5:30 p.m.

The Conference and Show fee ($5 to ASME members; $10 to nonmembers) provides the opportunity to participate in all of the sessions and includes admission to the Show and a copy of the Proceedings which will be distributed as soon as possible following the Conference. Papers will not be available in advance.

▶ MONDAY, JUNE 9

Session 1—Scientific Management in Materials Handling — 9:30 a.m.

Chairman: A. M. Smith, vice-president, Lamson and Sessions, Inc., Cleveland, Ohio

Application of Operations Research to Product Movement, by *D. B. Hertz*, manager, Operations Research Department, Arthur Andersen and Co., New York, N. Y.

Management Meets Competition Through Engineering, by *A. M. Perrin*, president, National Conveyors Co., Inc., Fairview, N. J.

Operating Characteristics of the Highly Automatic Plant, by *J. R. Bright*, associate professor, Graduate School of Business Administration, Harvard University, Cambridge, Mass.

The Systems-Engineering Approach to Materials Handling, by *Allan Harvey*, partner, Dasol Corp., New York, N. Y.

▶ TUESDAY, JUNE 10

Session 2—New Developments in Materials Handling — 9:30 a.m.

Chairman: *P. P. Rizzo*, manager of sales, Industrial Products Engineering Co., Long Island City, N. Y.

New Developments in Pneumatic Materials Handling—Improvements by Combination, by *H. A. Markel, Jr.*, chief engineer, Fuller Co., Catasauqua, Pa.

New Developments in Industrial Bulk Handling, by *G. A. Tambiyn*, sales manager, Industrial Handling Equipment, Material Handling Division, Yale & Towne Manufacturing Co., Philadelphia, Pa.

Application of Advanced Materials-Handling Techniques to Nonmass Production Plants, by *Jeré Helfat*, Booz, Allen & Hamilton, Cleveland, Ohio

▶ WEDNESDAY, JUNE 11

Session 3—Design and Development of Special Equipment — 9:30 a.m.

Chairman: *C. J. Schwarzer*, manager, Automotive and Metalworking Sections, Industrial Sales Department, Westinghouse Electric Corp., East Pittsburgh, Pa.

Design and Construction of High-Capacity Bulk-Handling Equipment, by *R. C. Tench*, materials-handling engineer, The Chesapeake and Ohio Railway Co., Richmond, Va.

Development and Research in Materials-Handling Equipment, by *O. S. Carliss*, director of engineering, Materials Handling Division, Yale & Towne Manufacturing Co., Philadelphia, Pa.

Development of Nuclear Handling Equipment, by *W. J. Dollart*, applications engineer, Atomic Power Department, Westinghouse Electric Corp., East Pittsburgh, Pa.

▶ THURSDAY, JUNE 12

Session 4—Materials Handling in Atomic and Space Age — 9:30 a.m.

Chairman: *Eric Berghaust*, executive editor, *Missiles and Rockets*, Washington, D. C.

Handling Problems With Radioactive Materials, by *Frank Ring, Jr.*, superintendent of design, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Materials-Handling Equipment in Missile Launching, by *Lieut. Col. C. M. Parkin*, U.S.A., Corps of Engineers, Fort Belvoir, Va.

Materials Handling in Logistics for Missiles, by *M. L. Mastracci*, project engineer, Mechanical Laboratories, American Machine and Foundry Co., Greenwich, Conn.

To Encourage Associate Members to Participate in Society Activities . . .

. . . ASME Chicago Section Holds Annual Technical Paper Prize Contest

THE Chicago Section of The American Society of Mechanical Engineers annually sponsors a Prize Paper Contest among Associate Members. It is the purpose of the contest to provide an opportunity for the Associate Members to participate in Section activities and to be recognized for their efforts. Papers are of a technical nature concerning the contestant's work or interests. Three papers, judged on the basis of the author's knowledge of the subject, interest, composition, content, and illustrations, are selected from all those submitted. The best three papers are then presented and judged on the basis of the over-all quality of the presentation.

Winners of first, second, and third prize for 1957 are: Frank A. Palmer, Commonwealth Edison Company; Ernest T. Selig, Armour Research Foundation; and Joseph P. Ryan, International Minerals & Chemical Corporation; all of Chicago, Ill.

"The Heat Cycle—Dresden Nuclear Power Plant," by Mr. Palmer, won first prize.

The application of the nuclear reactor to central station steam-power plants has resulted in numerous changes in the design of the steam-and-condensate system. The Palmer paper describes the Dresden steam-and-condensate system and the variations incorporated into the system design in order to improve the station heat rate, maintain high water purity, and safely handle radioactivity encountered.

The second-prize paper by E. T. Selig describes the "Response of an Elastic Building to Blast-Type Loading." A method is provided whereby a structural designer or analyst may rapidly investigate the effects of structural and blast loading parameters on maximum displacements, stresses, and strains in buildings. The buildings considered are those which may be represented adequately by a linear elastic, single-degree-of-freedom system. Blast loads considered are those represented by an initial impulse together with a suddenly applied linearly decreasing force. The designer is still faced with the problem of determining the values of the parameters which fit his particular case.

Mr. Ryan's paper, "Pressure Relief of Liquids in Pipelines," shows how to calculate the increase in volume and pressure in gasoline and oil lines, and the method of selecting pressure-relief valves.

Although the examples included deal with hydrocarbon liquids, the data can be applied to other liquids provided that they fall within the gravity range shown.

They came to **DALLAS, TEXAS**

—over 800 strong, to hear the latest reports on space travel, thermal thicket, human factors, and air transport at the

ASME-ARS AVIATION CONFERENCE

DALLAS, TEXAS, rapidly becoming a major center of aeronautical activity, was converted into a Space-Age city for five days, March 16-20, during the 1958 Aviation Conference, jointly sponsored by the Aviation Division of The American Society of Mechanical Engineers and the American Rocket Society. Overflow crowds flocked to the Statler-Hilton Hotel, scene of the meeting, to hear a special lecture by Wernher von Braun on Explorer I and a panel session on lunar colonization, moderated by Major David G. Simons, who has been closer to the moon for a longer period than any other human on earth. Sophisticated fuels, the first forum on "drones," the problems of local airlines, pilot-escape capsules, dual-thrust rockets, and data acquisition—these are the high lights gleaned from more than 70 technical papers presented at 23 technical sessions.

Von Braun on Explorer I

Almost 1300 people remained glued to their seats for one hour and 50 minutes as Wernher von Braun of the Army Ballistic Missile Agency revealed details of the launching of America's first satellite, Explorer I. He started his talk with high praise for the Navy's Vanguard, which had just been successfully launched. He called it "a much more sophisticated missile than ours." It was "unheard of," he said, "to develop so complicated a mechanism in so short a space of time."

In contrast, the Army missile team approached the Explorer I launching with "almost cocky confidence" because existing hardware was used and "we had time to make all our mistakes in the past," he said.

In a casual manner, Dr. von Braun explained, with slides, how the missile was put together, made ready, and fired.

He revealed that a new fuel was used, but said, "I can't mention it here because of security, but you can read all about it in a recent ARS publication," and the audience howled with laughter. This permitted a boost in thrust from 75,000 to 83,000 lb. There also was an increase in burning time (from 117 to 150 sec) partly due, however, to larger propellant tanks, made possible because the satellite weighs less than the warhead designed for the original Redstone.

When the pressure in either of the two propellant lines drops low enough, a sensing device shuts off the rocket motor and triggers six explosive bolts holding the first and second stages together.

The Statler-Hilton

And they saw **Rear Admiral Rawson Bennett, *left,* Chief of Naval Research, who spoke at the ARS Luncheon and, *right,* an innovation—the self-service preprint table which allowed leisurely inspection and at the same time speeded up transactions with the service staff**

Springs then push apart the two stages which, the speaker jokingly said, "adds about one pound of additional thrust."

Approximately 400 sec after launch, the second and third stages have been exhausted and the missile is "coasting." The next step, firing the satellite stage, is the most critical in the entire flight. Its attitude with respect to the earth must be just right—if not, a successful orbit will not be achieved. Information about this critical point is fed into a ground computer from three sources: (1) radar, (2) an accelerometer, and (3) a Doppler device. Uncannily, it seems, each signal is measured for quality and its value weighted before the computer determines the exact moment of firing. Explorer I was actually fired with an angular error of only 0.8 deg, although as much as 4 deg would still have permitted a successful orbit.

Revealed for the first time in public, were the temperatures that have been "beeped" back to the earth. "They have surprised us. They seem to range from just below freezing to what you'd expect in the Arizona desert at noon (30 to 120 F)," he said. Inside the pencil-shaped satellite, near the low-powered radio transmitter, the range is from 100 to 120 F. Temperatures were governed by whether or not the vehicle was in direct sunlight. Because of this, the proper day and time to launch a satellite are largely governed by the percentages of sunlight and darkness it will encounter in its orbit. Astronomers' charts, on which this information is plotted for an entire year, will be popular in the future, Dr. von Braun said.

Firing delays usually come near the end of the countdowns because, he said, "the closer you get, the more equipment is turned on and the more things can go wrong."

Explorer II, the "Satellite That Failed," was within 2 per cent of completion when the fourth stage stopped functioning. "So you see," said von Braun, "this proves that 98 per cent success isn't enough in this business."

Lunar Colonization

Moderated by Major David G. Simons, hero of the Air Force's Operation Man-High balloon space flight, a panel of experts on lunar colonization agreed that man "undoubtedly" will be able to inhabit the moon—in perhaps as soon as 10 years—despite a maze of complex problems.

Some of the key problems were first listed by Dr. Clyde Tombaugh, the noted astronomer who discovered the planet Pluto in 1930. These are:

1 Oxygen supply. Taking along pure oxygen presents too great a weight penalty for a rocket flight and scientists may, instead, use green algae which absorb carbon dioxide and give off oxygen by photosynthesis.

2 Food. Again algae are the consideration, but they would be a poor diet. The answer may lie in hydroponics—that is, growing food in pure water.

3 Temperatures. The moon undergoes vast changes in temperature, from far below zero at night to as high as 230 F in the shining sun. Asbestos shoes will be standard equipment for explorers.

Dr. E. B. Konecci of Douglas-Tulsa, discussed the psychological problems and said, "Man will be faced with boredom, lack of privacy, sleeplessness, and even neurosis. We must capsulate a complete environment to keep him as normal as possible."

The specific requirements for a permanent base of operations were outlined by Irwin Cooper of the Rand Corporation.

Studies of submarine crew life will be of great help in evaluating the factors that go into "selecting the man," said human-factors specialist Arnold Small of Convair. "We have to get him back not only safe, but also sane!"

Other Technical High Lights

ASME's part of the technical program revealed a variety of interesting developments for the aviation industry, some of which follow:

Fuels. Powerful new aviation fuels to deliver longer range with smaller fuel loads will soon be in use in civilian and military aircraft, according to one report. Several types of fuel are now in production and others are being considered and tested. The paper outlined the new types of fuel and noted that they cover the whole range of aircraft from conventional piston engines to liquid-fueled rockets.

A new high-energy gasoline additive, now in production, will give piston engines more power per gallon, thereby enabling commercial flights to increase either their paying cargo or their flying range. Despite a higher cost for the fuel, airlines should realize a net saving in operating cost of approximately 3 per cent, not even taking account of anticipated savings in engine overhaul cost.

For jet planes pyrophoric fuels (liquids that ignite spontaneously in air) seem to produce much better over-all results than any other type tested so far. Three types of pyrophoric fuels under examination are triethyl aluminum (TEA), triethyl boron (TEB), and trimethyl aluminum (TMA). They can be produced in large volume at reasonable prices and permit the same amount of thrust to be taken from a smaller, less complicated, and more reliable engine

And they heard, *left to right,* **John Coutinho, Grumman Aircraft, at the Challenges of High-Speed Flight session; Major David Simons, moderating the Lunar Colonization panel; The Hon. R. E. Horner, Assistant Secretary of the Air Force for Research and Development speaking at the Banquet with Toastmaster J. E. Jonsson, president, Dallas Chamber of Commerce, at his right; and Jerome H. Ely, Dunlap and Associates, at the Human Factors in Engineering session**

than do other fuels. A ramjet engine that burns pyrophoric fuel has been designed for constant altitude target drone or missile application. It weighs only 18 lb and can develop a velocity one and a half times greater than the speed of sound. A $600 engine is possible compared with a price of up to $10,000 for a similar unit using conventional fuels.

Aircraft Escape System. A new system for parachuting a man back to earth from extreme altitudes, without exposing him to perilous hazards, was described. The device, which consists of a closed capsule and a system of parachutes is designed to be ejected from high-flying supersonic aircraft. It overcomes many of the same problems that might be faced by a returning space traveler.

The difficulties facing designers who try to get a planeless pilot safely and painlessly back to earth were outlined. It was pointed out that engineers must provide complicated ejection units that will not subject the pilot to unbearable acceleration or deceleration. Several types of capsules are under consideration, including those that consist of the entire pressurized cockpit, the whole front end of the plane, a minimum-size seat capsule, and a compromise version which houses pilot, seat, and some control instruments.

High-Temperature Radiation. Development of rockets, missiles, and nuclear devices that operate at high temperatures may soon be given a huge push forward. The advances are expected to stem from a new device which allows researchers to learn more about what happens to heat-resistant materials at temperatures near 6000 F. The new unit is a laboratory device in which specimens of various materials can be exposed to intense heat, created by focusing the rays of the sun in a huge curved mirror. Special equipment enables experimenters to measure and control temperatures closely.

Variable Incidence Wings. Man has moved another step closer to nature's way of doing things aeronautically. Now, a pilot can move his plane wings to take advantage of different conditions while in flight. The advantages are: Good visibility for landing without the need for a canopy above the fuselage and shorter landing gear because the plane's fuselage need not be tilted on take-off and landing. The shorter landing gear takes up less space in the plane, giving advantages in weight, location of other equipment, and increased fuel capacity.

The wing-moving mechanism is a 30-lb hydraulic actuator already in use in the Navy F8U-1 Crusader fighter plane. When the pilot moves a lever, a spring-loaded brake is unlocked and the mechanism changes the wing's angle of incidence. A loss of pressure during actuation causes the brake to re-engage, locking the actuator at the position where pressure is lost. To prevent very fast and potentially unsafe operation, the actuator has a built-in relief valve.

In case the normal operating system fails, the wings can be moved by pneumatic pressure obtained from air bottles.

Field Trips. A choice of three field trips in the Dallas area was offered to attendees: To Astrodyne, Inc., producers of solid rocket propellants; to Chance Vought Aircraft, Inc., and Convair for an inspection of subassembly and final assembly operation of the Navy F8U-1 Crusader and the Regulus II guided missile, as well as a view of the B-58; or to Texas Instruments, Inc., and Southwest Airmotive, where jet engines are overhauled.

Luncheons and Banquet

Chief of Staff of the U. S. Air Force General Thomas D. White at the Welcoming Luncheon, on Monday, discussed our "Air Power's Progression Towards Space Power."

Today, air power is the key to survival, he said. In the near future the key will be both air power and space power.

Four characteristics, he pointed out, distinguish air power from land or naval power. These are: (1) Reaction—which encompasses many factors such as mobility, air-lift capacity, communications, and world-wide air bases; (2) fire power—employing a wide range of weapons that are flexible and diversified; (3) penetration—the ability to put fire power where it hurts an enemy most; and (4) selectivity—based on the great flexibility of operations. He felt there would be no change in these characteristics as air power becomes space power but reaction will be quicker, fire power more lethal, penetration deeper, and selectivity greater.

General White is convinced that man in space will be the most important factor. "I cannot conceive that mechanical gadgets will control space. Man will! The judgment and skills of man will always be needed to achieve the greatest effectiveness," he stated.

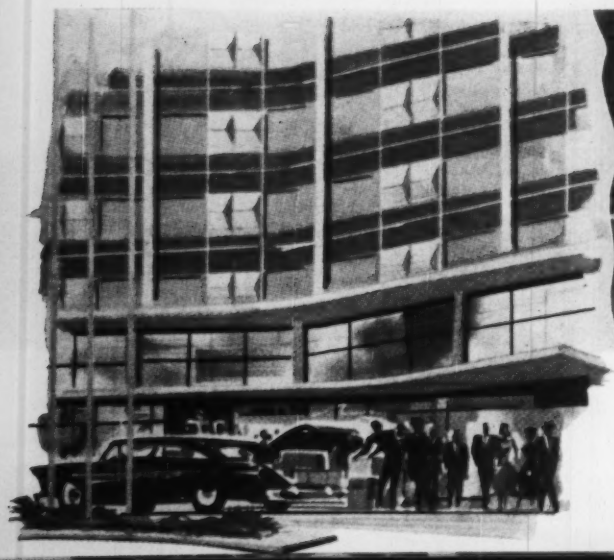
Much work remains to be done. To get heavier pay loads away from the earth, initial thrusts of over one million pounds must be reached and, in order to keep on going, nuclear power, ionic power, and highly sophisticated chemical fuels are being considered.

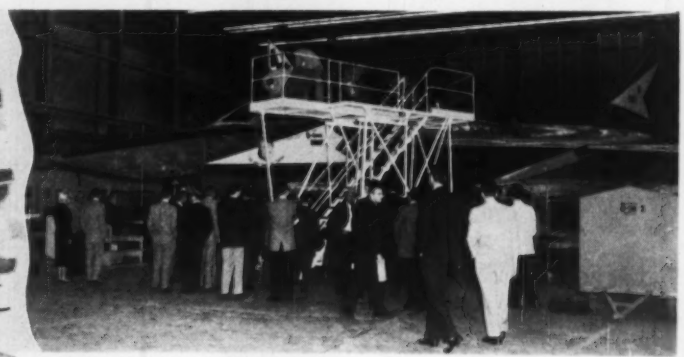
At Tuesday's luncheon, the main speaker, Rear Admiral Rawson Bennett,

Before they left the

ASME-ARS AVIATION CONFERENCE

They visited **the Fort Worth plant of Convair to see how the B-58 is assembled. This plant has over 11 million sq ft of paved working space. The B-58 was demonstrated in flight as well.**





Chief of Naval Research, emphasized that we have a lack of communication in engineering research and development. For example, he said, we have no good scheme for searching the technical literature on a nationwide scale. There must be higher priority for this.

Much depends on the abstract, according to Admiral Bennett. We need more experts who can understand abstracts. They are not sufficiently expert now to classify the material properly. The Russians are using 1200 people to classify information. We don't even come close to this, he declared. He suggested that we make mandatory certain types of information in abstracts of all articles, such as:

1 What is the most important single result—mention page number (also, have authors mention negative results).

2 What is the most important idea and on what page number.

If communication is improved it will shorten transition time from research to hardware which is the key to shortening the lead time that is always being mentioned.

It will also eliminate work that is inadvertently being redone or efforts that parallel one another.

The race for the conquest of space is today's major engagement in the technological war; we must win it to insure our national security. So said Lieut. Gen. S. E. Anderson, Commander of Air Research and Development Command, at Wednesday's luncheon.

One of the real and tangible evidences of Air Force action in pushing farther into space is the development of X-15, a man-carrying craft that will be capable of speeds in excess of 3600 mph. General Anderson stressed the military-science-industry team at work on the X-15 project. The customer is the NACA. Directing and managing development and flight research is an Air Force responsibility. The Navy will provide support with its human centrifuge at Johnsville, Pa. North American Aviation will design and build the plane. "This cooperative spirit should be highlighted," he said, "since of recent months much has been made of the interservice rivalries which are supposedly impeding progress."

The Air Force has a long and planned program for flying man higher and faster with no limit being drawn in the sky. It is not the product of "an hysterical reaction to the Soviet Sputniks," he emphasized.

"But, why put man up there?" asked the General. There are many reasons. Man can make complex judgments and decisions based on information that cannot be anticipated and, therefore, defy electromechanical programming. Man can observe, identify, and compare, and then monitor, analyze, and choose from among sources that are most likely to be accurate. He can aid or confuse trackers. Once at the mission he can even call the whole thing off if necessary.

The main address at the Banquet was delivered by the Hon. Richard E. Horner, Assistant Secretary of the Air Force for Research and Development. Military research inevitably filters down to the civilian level and in this country people today enjoy such wonders as TV, radar-equipped planes, jet transports, and aircraft air conditioning and pressurization because of the pioneering work done by the Air Force, he pointed out. Tomorrow, we will be using supersonic transports, satellite TV-relay stations for world-wide broadcasts, and perhaps space travel.

With the vast increase in the complexity of machinery, the small numbers of weapons needed with atomic explosives, and the model-shop quantities that are used in astronautics, research, and development are becoming ever more important, he added.

He urged a sympathetic understanding of problems in order to permit a forward-looking, continuous program.

Demonstration firing of JATO units and large booster rockets under development at Astrodyne, Inc., in McGregor, Texas

Availability List—ASME Aviation Conference Papers

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58—AV-1 Mechanical Design in Aircraft, by H. E. Cornish
58—AV-2 Variable-Incidence Wing-Operating Mechanism, by D. M. Bland
58—AV-3 The Quest for Operational Integrity of New Aircraft Systems, by J. de S. Coutinho
58—AV-4 Flight-Control Linkages, by R. L. Roemer
58—AV-5 Aviation's Golden Age, by J. E. Forry
58—AV-6 Designing and Testing for High-Temperature Hydraulics, by F. L. Moncher and L. D. Taylor
58—AV-7 Mechanical-Engineering Aspects of the High-Speed Aircraft Escape-System Problem, by C. W. Russell
58—AV-8 Monitoring of Hydraulic Fluids During High-Temperature Testing, by R. L. Leslie
58—AV-9 Why Quickening Works, by H. P. Birmingham and F. V. Taylor
58—AV-10 Designing Controls for Human Use, by J. H. Ely
58—AV-11 Metallurgical Factors in the Design of Hydraulic Equipment for Elevated Temperature Application, by A. Mars and N. M. Lazar
58—AV-12 Operations Planning for Introducing New Aircraft Into a Local Service Airline System, by T. H. Davis
58—AV-13 Airframe Design for Local Airlines Operation, by W. H. Arata, Jr.
58—AV-14 Ball Motion and Sliding Friction in Ball Bearings, by A. B. Jones
58—AV-15 Philosophy and Mechanization of an Air-Data Computer, by J. H. Andresen, Jr., and H. F. Colvin, 3rd
58—AV-16 Servoed Pressure Transducers as Air-Data Inputs, by S. E. Westman
58—AV-17 Total Temperature Measurements, by F. D. Werner
58—AV-18 Force-Balance Pressure-Measuring Sensors, by G. P. Knapp
58—AV-19 Introduction of New Transport Designs . . . and Their Effect on Traffic Potential for Local Service Airlines, by W. J. Mitchell
58—AV-20 Solid Lubricant Coatings, by L. Berry
58—AV-21 Air Conditioning the B-58 . . . Progress Report, by J. I. Koger and W. B. Bennett
58—AV-22 Low-Power Engine-Component Tests . . . Simulation of High-Speed Flight Conditions and Design of Equipment, by R. L. Penrose
58—AV-23 Cabin Cooling for the Douglas Jet Transport, R. N. Krueger
58—AV-24 Studies in Aircraft Maintenance Productivity Analysis, by I. J. Kessler
58—AV-25 Local Service Airlines and the Jet-Engine Overhaul Problem, by J. E. Lockart and A. Harting
58—AV-26 High-Energy Aviation Fuels, Their Promises and Problems, by Robert A. Wells
58—AV-27 The Allison 501-D13 Jet Engine and Its Place in the Air Transport Industry, by J. D. Beaumont
58—AV-28 On a Stationary Temperature Separating Device Used as a Measuring and Cooling/Heating Apparatus, by P. H. Bavet
58—AV-29 On the Measurement of High-Temperature Radiation Properties of Solids, by P. E. Glaser and H. H. Blau, Jr.
58—AV-30 Criteria for Local Airline Equipment, by B. J. Herkimer

sixth annual conference of asme management

1 Management engineers foregather at Boston's Somerset Hotel for annual conference. 2 W. T. Alexander, dean of engineering, Northeastern University. 3 L. E. Newman, president, A. L. Smith Iron Company. 4 H. B. Maynard and T. N. Graser converse with Dr. Lillian M. Gilbreth, wife of the late pioneer in management, and herself a leading industrial consultant. Long a member of ASME, she became an Honorary Member in 1950. 5 A. M. Lederer, Chairman of CIPM, main speaker at the banquet. 6 C. E. Crede, vice-president of the ASME's Region 1.

THERE are mysteries in management. Not because anybody wants to be secretive or obscure: On the contrary, the top men meet—as they just met in Boston—to tell their confreres and the entire engineering world how they do it. But the tasks faced by the management engineer contain the infinite complexity of the human element, eluding mathematical analysis.

The engineers who attended the sixth annual conference of the Management Division of The American Society of Mechanical Engineers are the men who seek solutions to the toughest of all engineering problems—making industry run.

A Joint Project

The conference, held jointly with the American Institute of Electrical Engineers, and in co-operation with the Boston Sections of both Societies, took place March 19–20, 1958, at the Hotel Somerset, in Boston, Mass. Some 200 engineering executives—and teachers and analysts of management—gathered to hear and discuss technical papers dealing with "Planning Ahead and Measuring Progress" and "Management in Action." There was a luncheon at which L. E. Newman, Mem. ASME, president, A. L. Smith Iron Company, spoke on "Philosophies of Management." At the banquet, held Wednesday evening in the Somerset's Regency Ballroom, A. M. Lederer, Mem. ASME, chairman of the Council for International Progress in Management (USA), Inc., spoke on the work of the International Committee on Scientific Management (CIOS).

There were field trips to Stone & Webster, builders of engineering plants throughout the free world; to Arthur D. Little, Inc., consulting engineers of world-wide reputation; and to the School of Industrial Management of M.I.T. Unfortunately, these field trips were scheduled for Thursday afternoon, at the end of the Conference, and the blizzard, already tieing up New York and known to be moving on Boston, impelled many to head for the airports.

In Convention Assembled

The morning session on Wednesday heard two technical papers. H. B. Maynard, Fellow ASME, president of H. B. Maynard and Company, Pittsburgh, Pa., argued the need for broad vision by top management if dynamic leadership were to be maintained. O. E. Rodgers, Mem. ASME, engineering manager, Utica Bend Corporation, reviewed ways of obtaining information on competitive products and methods of using this information in engineering program planning.

At the afternoon session, Ralph Kelmon of Boston Edison discussed financing, one of management's many projects that must be accomplished "with people." G. R. Northrup, Mem. ASME, of Philco discussed short-term and long-term development, bringing out factors that influence each type of program. S. W. Herwald, Mem. ASME, of Westinghouse took up the problem of planning facilities in the face of rapidly changing products and rapid development of totally new products.

On Thursday morning, the Conference heard from L. W. Bass of Arthur D. Little Company, Howard W. Johnson of M.I.T., and J. J. Niland of Stone & Webster. Mr. Bass discussed the co-ordination of research, development, and engineering. Mr. Johnson spoke of some of the personal deficiencies that block the engineer from becoming an effective manager, and outlined programs for bringing the engineer out of his scientific shell, and giving him the rounded personality and depth of understanding required for management. Mr. Niland, the last technical session speaker, took up the role of the project engineer who, in addition to engineering talent, needs managerial ability, especially the ability to communicate with people.

The success of these conferences makes long-range planning necessary. The seventh Annual Management Conference will be held in Los Angeles, Calif., Sept. 16–18, 1959, at the Statler. In addition to the ASME and the AIEE, several other engineering societies plan to join in the sponsorship, giving new depth to the program.

Luncheon and Banquet Speakers

The conference had distinguished speakers, both for its luncheon and its banquet. At the luncheon, L. E. Newman expressed his belief that a manager's philosophies may be more important to his success than his skills. For a ready illustration of the need for principles or philosophies, he suggested:

"Shall promotion be from within, or shall the best qualified candidate be

sought, whether he be inside or outside the company?"

"Shall compensation be geared primarily to length of service, or to performance?"

He then explored some of the principles by which we live, touching on structure, personal judgments, promotion, leadership, employee relations, and ethics.

At one point he said, "It is my belief that the large majority of the men reaching top positions today have done so . . . because of having individual standards of integrity that commanded the respect of those around them."

At the banquet, A. M. Lederer, president, A. M. Lederer & Company, Inc., spoke on "The Present Position of the International Management Movement," a progress and evaluation report on work in this field in the United States. This work is done largely through membership in the Council for International Progress in Management (USA), Inc.—known as CIPM. Mr. Lederer is chairman of this council.

"In that membership," he said, "ASME is joined by seven outstanding management groups, approximately 100 industrial organizations, and some 30 educational institutions. However, in spite of this notable membership, CIPM would probably not have been possible without the active, loyal, devoted, and inspirational support of ASME."

Mr. Lederer brought out the fact that the international movement began when the late Thomas G. Masaryk, first president of the then newly created nation of Czechoslovakia, became impressed with American industry during World War I, and suggested to Herbert Hoover that the techniques and principles be brought to Europe. Among the early architects of the movement were Dr. H. A. Hopf, William L. Batt, the Gilbreths, C. E. Davies, and Wallace Clark, all of the ASME. From the need to organize an international body to promote and foster management congresses there developed, in 1927, the CIOS (Comite International de l'Organisation Scientifique), with headquarters in Geneva.

What have our management men and our exchange professors in management carried abroad?

"Techniques—yes," said Mr. Lederer. "But more fundamentally they have pointed out to their counterparts that our techniques are founded on a philosophy of managerial responsibility which recognizes and accepts its position as the fifth, the generating and deciding force—serving consumer, labor, owners, and government alike, responsible to and for society. . . The fact is that CIOS is the only international management organization encompassing all the functional aspects of managing in home, farm, public institutions, and business."

Management men of Australia have taken on the job of organizing the Twelfth International Management Congress, to be held in Australia in 1960. Our own country has proposed to hold the thirteenth Congress in the United States in 1963. In the meantime, the European section of CIOS will hold a European Conference in Berlin, in October, 1958, to explore the managerial problems facing managers in the European common market.

Mr. Lederer told of the first Pan American Conference, held in Chile in 1956, and organized by the ICARE (Instituto Chileno de Aministración Racional de Empresas). When the registration from practically all countries of the Western Hemisphere exceeded all available hotel accommodations in Chile, ICARE had to turn away more than 300 would-be participants and confine itself to an attendance of slightly over 500. It was, he said, a compelling demonstration of Pan American thirst for management knowledge, a powerful interest aroused, almost overnight, to dynamic action.

Mr. Lederer quoted Webster's second definition of a movement: "An agitation in favor of some principle."

"I hope," he said, "that I have brought you the realization of your own participation as ASME members in an international agitation in favor of the principles of modern managing by free consent of the managed. . . It is a noble, and must be an enduring, task."

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58—MGT-1 Planning Facilities in the Face of Rapid Obsolescence, by S. W. Herwald

58—MGT-2 Integrating Effort in Long and Short-Term Programs, by G. R. Northrup

58—MGT-3 Evaluation of Technical Programs, by L. W. Bass

58—MGT-4 Planning and Control of Integrated Design and Construction Projects, by J. J. Niland

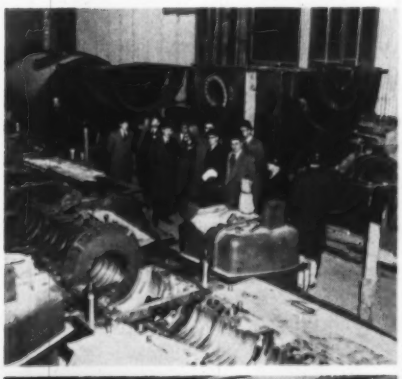
58—MGT-5 The Development of Engineering Personnel for Management Responsibility . . . An Answer to the Question, "Do Engineers Make Good Managers?" by H. W. Johnson

58—MGT-6 Competitive Position as a Measure of Engineering Progress, by O. E. Rodgers

58—MGT-7 Financing for the Future, by R. M. Kelmon

division held in Boston

ASME joins with AIEE in bringing together the engineers who design, build, and operate the nation's industrial organizations



Field trips for engineers of the ASME and AIEE attending the management conference. *Above:* Plant under construction by Stone & Webster for New England Electric System. *Below:* Inspecting an ADL-Collins Helium Cryostat during the tour of the Engineering Division, Arthur D. Little, Inc., industrial research consultants. M.I.T. also received the conferees.

Wood Industries Conference

Forest Products Research Society joins ASME to report progress in the wood industry

1

2

3

Seen at Wood Industries Conference. 1 Glenn B. Warren addresses banquet audience. 2 Hardy L. Shirley, dean, State University College of Forestry, welcomes conferees. 3 F. H. Kaufert tells of forestry research progress. 4 Crowd registers early and checks up on technical papers.

4

THE 1958 Wood Industries Conference, designed to review progress in the wood industry and report on applied research in wood products, was held March 30 through April 1 at the Hotel Syracuse and the State University College of Forestry at Syracuse, N. Y.

Sponsored jointly by the Wood Industries Division of The American Society of Mechanical Engineers in co-operation with the ASME Syracuse Section and the Northeast Section and Eastern Canadian Section of the Forest Products Research Society, the professional program—international in character—attracted a large audience of engineers whose work contributes much to the industry's advancement.

The three-session program consisting of ten technical papers featured luncheons, a banquet, and two panel discussions.

Three ASME papers discussed research in new abrasives and wood surfacing, and performance characteristics of spring-set circular ripsaws. Other papers evaluated laminating progress being made in Canada and the production of bondwood.

Featured on the program was an authoritative, eyewitness account of "A Canadian's Camera View of Russia's Forest Industry," by Col. J. H. Jenkins who is chief of Forest Products Laboratories of Canada at Ottawa, Ont. Another film by the Bureau of Ships, U. S. Navy, documented the use and maintenance of carbide tools for woodworking.

Two panel discussions, presented simultaneously, covered in one the equilibrium moisture content of several domestic and tropical woods, and techniques for studying resin coverage of particles and, in the other, urea resins in hardwood-plywood gluing, and in R. F. and steam-heated platen-edge gluing, polyvinyl resins in laminating operations, and animal glues in assembly and edge-gluing operations.

On Tuesday, the morning session took up the mechanism of moisture movement in beech, granuplast molding, testing, and the durability of exterior natural finishes, and the Hugh P. Baker Wood Products Laboratory of the State University College of Forestry. The conferees visited this ultramodern lab, completed in 1957, later in the afternoon. Built at a cost of nearly $4 million, the lab was designed and equipped solely for education and research in wood and wood products.

At the lab, visitors inspected modern machines and instruments, saw techniques illustrating some of the conference papers, and special facilities for exploring in detail the physical and chemical properties of wood as well as research projects in progress at the College.

The banquet guests heard FPRS President F. H. Kaufert tell that his 12-year-old society was established to stimulate research. He remarked that when he made a study five years ago, the industry invested 0.002 per cent on research whereas many industries spent as much as three or four per cent. Today the amount is probably greater, but still below other industries.

Glenn B. Warren, a director of ASME, congratulated FPRS on a fine record of accomplishment and remarked on the importance of the awards being made to young men for technical papers of excellent quality. Mr. Warren also related how the ASME Professional Division conferences grew out of the need to properly accommodate reports of new developments in the various fields of engineering when national and Section meetings could no longer adequately handle the volume of resulting material.

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58—WDI-1 Research in New Abrasives, by E. J. Sterba

58—WDI-2 Performance Characteristics of Small Spring-Set Circular Rip Saws, by E. Y. Wheeler and R. J. Hoyle, Jr.

North Carolina State College • March 20-21

"Cost control through engineering" is the thread of textile engineering *conference*

TEXTILE men from North and South—mill men, machinery manufacturers, and educators—gathered together and spun a yarn—the story of the textile industry today—at the Textile Engineering Conference of The American Society of Mechanical Engineers. "Cost Control Through Engineering" was the warp which ran through the two-day conference, March 20–21, at North Carolina State College, Raleigh, N. C. The ASME Textile Engineering Division sponsored the conference with the cooperation of three ASME local sections, Eastern North Carolina, Piedmont-Carolina, and Greenville, S. C.

Welcomed to Raleigh and NCSC by J. H. Lampe and M. E. Campbell, deans of the school of engineering and the school of textiles, respectively, the confreres (about 150) began their two-day conference.

The textile plant of today and tomorrow and engineering advancements in processing machinery were the subjects of the first day's sessions and formed the warp for the conference. The second day, devoted to informal round-table discussions by delegates—the woof—completed the weave. An informal luncheon and a banquet added color and finished off the well-textured fabric of a successful conference.

The Plant

Cost control through engineering in the textile industry as well as in other industries may be achieved by careful attention to detail. Likewise, the modern industrial plant or mill must be planned with careful attention to location, size, shape, and design, in order to achieve most economical and efficient operation.

The trend today is toward one-story construction of the mill. This decreases the need for pillar support and provides more space for arranging batteries of machines, allowing increased production, efficient flow of materials, reduction of handling, and, finally, lower cost per pound. Accurate regulation of moisture content and temperature for each room of the mill improves the quality of the product and the environment for the employees. High-speed modern equipment makes it necessary to consider noise control. Dust control and improved lighting must also be noted in planning for the mills of today and tomorrow. Windowless construction, made possible by air-conditioning and indirect lighting, appears to characterize the modern mill.

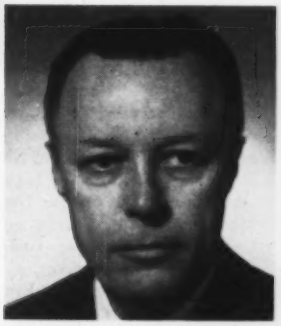
Mechanical handling is another characteristic feature of the modern mill which contributes to cost control in the textile industry. Lift and platform trucks; truck towlines; wheel and roller, belt and live roller, pallet, and overhead conveyers—all are available and can find application in the modern textile plant. A component and systems approach to the design of a mechanical-handling system allows efficient selection of the over-all materials-handling scheme which contributes to cost control by replacing time-consuming and expensive manual moving.

The Machinery

It is conventional in histories to trace the Industrial Revolution—prelude to modern mechanization—by noting inventions in what was the key industry of the early revolution, the textile industry. Often, in surveying textile machinery and fabric-processing equipment, it appears that little progress has been made since those early days. While, on the surface, looms and cards today bear startling similarity to their predecessors, the industry has progressed considerably.

Reduced costs and improved quality have resulted from such innovations as elimination of certain processes, use of higher speeds, and larger package size. Systems have been made more versatile, looms have been made more fully automatic, protection and stop-motion devices have substantially improved, and loom speeds increased significantly. Machinery is better built and requires fewer repairs. Styling has been improved.

Increased precision is an advance which is effecting improved quality. Great progress is being made in the science of measurement and the textile industry is



ASME Textile Engineering Conference General Session, *top.* Shown, *clockwise,* banquet speaker, W. H. Ruffin. Speaker, J. C. Whitehurst, Mem. ASME; E. M. Ketchie, Mem. ASME, and A. C. Thies, Mem. ASME, vice-chairman and chairman, respectively, Piedmont-Carolina Section ASME. Speaker, Kenneth Fox, Mem. ASME. E. B. Grover, program chairman, NCSC; and speaker, A. Bahnson, Jr., Bahnson Co., Winston-Salem, N. C.

benefitting from the use of such devices as electronic evenness testers and the spectrogram.

In the area of greater life for machinery, there has been a definite trend toward the use of antifriction bearings. Reduced torque and power consumption and long bearing life with minimum wear are some of the results, but, perhaps, the greatest benefit derives from extended lubrication schedules. Better bearing mountings and unit construction, where assemblies are self-contained and can be removed from the machine in one piece, also are effecting longer and better machine life.

The Product

Desirable fabrics must, among many other factors, be appealing in terms of color, texture, hand, draping qualities, and so on. Furthermore, the fabric must have a satisfactory performance in use. The industry today is emphasizing functional performance of textiles, and satisfactory fabrics are available which fulfill almost all end-use requirements. New fiber fabrics and blends, finishing agents, and nonwovens are the most notable examples of this trend.

Banquet

Speaker at the banquet, W. H. Ruffin, president, Erwin Mills, Inc., Durham, N. C., advocated broader education in the field of science. He urged that the engineering student be given as many liberal arts courses as possible. He encouraged this not only for the personal satisfaction of the engineering graduate, but also because the engineering graduate, today more than ever, is progressing to top administrative positions in manufacturing and in business.

Mr. Ruffin expressed disappointment that the rapid increase in population and in the standard of living in this country have not yet caught up with the textile industry's manufacturing facilities, but called attention to the fact that it is freely predicted that this will soon take place.

He strongly expressed his confidence in the future of the textile industry.

Fourth Automation Congress to Feature Instrumentation, Automatic Control, and Materials Handling

"Materials Handling as a Key to Industry Automation" will be the theme of four sessions arranged by the Materials Handling Division of the ASME in the program of the Fourth International Automation Congress and Exposition to be held at the New York Coliseum, June 9–13, 1958.

These four sessions will be a part of a broad conference in the automation field that also will feature sessions on instrumentation and automatic control. Carl F. Kayan, Mem. ASME, professor and executive officer of the Department of Mechanical Engineering of Columbia University, is Honorary Chairman of the Congress. The Exposition under the management of Richard Rimbach Associates, Pittsburgh, Pa., will feature the latest developments in automation and will fill the second floor of the Coliseum.

The conference fee ($2 to ASME members; $5 to nonmembers) provides the opportunity to participate in all of the sessions and includes admission to the Show.

▶ TUESDAY, JUNE 10

Session 1—Automatic Warehousing — **9:30 a.m.**

Cost Considerations in Justifying Automation, by *F. W. Wanzenberg,* assistant manager, Automatic Mechanisms and Processes, Mechanics Research Division, American Machine & Foundry Co., Chicago, Ill.

An Automatic Warehousing Installation Using Static Control, by *L. L. Bosch,* partner, Bosch & LaTour, Engineers-Consultants, Cincinnati, Ohio

▶ TUESDAY, JUNE 10

Session 2—Automatic Materials Handling Systems in Small Plants and Warehouses — **2:30 p.m.**

Recent Progress in Automatic Proportioning of Materials, Programming, and Readout, by *Ingraham Richardson,* president, Richardson Scale Co., Clifton, N. J.

Planning for Automatic Handling, by *R. W. Mallick,* consulting engineer, Pittsburgh, Pa.

▶ WEDNESDAY, JUNE 11

Session 3—Automation on the Production Line — **9:30 a.m.**

Automation of an Integrated Production Line, by *J. C. Webb,* president and general manager, Jervis B. Webb Company, Detroit, Mich.

Operating Characteristics of the Highly Automatic Plant, by *J. R. Bright,* associate professor of business administration, Harvard University, Cambridge, Mass.

▶ WEDNESDAY, JUNE 11

Session 4—Systems Engineering—Economy and Justifications — **2:30 p.m.**

The Systems-Engineering Approach to Materials Handling, by Allan Harvey, partner, Dasol Corp., New York, N. Y.

Automation and the Scientific Laboratory From a Systems Viewpoint, by *A. G. Rawling,* research engineer, Johns Hopkins University Applied Physics Laboratory, Silver Spring, Md.

ASME COMING EVENTS

May 11–15

ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 9–12

ASME Materials Handling Conference, Cleveland Auditorium, Cleveland, Ohio

June 11–14

Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I. (ASME is cosponsor.)

June 15–19

ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

August 18–21

ASME Heat Transfer-AIChE Conference, Northwestern University, Evanston, Ill.

September 4–5

ASME Second International Congress on Air Pollution, Hotel Statler, New York, N. Y.

September 8–9

ASME Applied Mechanics Western Conference, University of California, Los Angeles, Calif.

September 15–17

ASME Process Industries Conference, Hotel Statler, Buffalo, N. Y.

September 21–24

ASME Petroleum Mechanical Engineering Conference, Cosmopolitan Hotel, Denver, Colo.

September 28–October 1

ASME Power Conference, Hotel Statler, Boston, Mass.

October 9–10

ASME-AIME Fuels Conference, Hotel Champlain, Old Point Comfort, Va.

October 13–15

ASME-ASLE Lubrication Conference, Hotel Statler, Los Angeles, Calif.

November 30–December 5

ASME Annual Meeting, Hotels Statler and Sheraton-McAlpin, New York, N. Y.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(For Meetings of Other Societies, see page 127)

Conducted for the National Junior Committee

N. J. VIEHMANN[1]

JUNIOR FORUM

The Engineer's Place in Industrial Management[2]

By Frank W. Miller[3]

A PARTNER in a management-consulting firm suggests that the embryo of a new industrial company is composed of a good salesman who has become dissatisfied with the scope of his activity and an able foreman whom he selects as superintendent. These two men start a new company. As growth follows hard work and imaginative policies, it becomes impossible for the original owner adequately to satisfy the demands for his time. Key men are progressively assigned in management positions as the company grows.

Engineers as Managers

Are engineers fully qualified to fill these management positions? Ten small industrial companies were invited to relate their experiences to assist in answering this question. The percentage of engineers in executive and managerial positions in these ten companies was found to vary from 60 to 80 per cent. This is a most impressive number. But, in a subjective sense, have engineers been drafted to management positions only because they can contribute to the solution of engineering problems? Are they without an adequate knowledge to solve the many problems other than engineering that are part of a successful manager's normal business life?

The engineer has not generally been prepared for management positions in his formal educational training. The college curriculum has been devoted, and to a large extent is still devoted, to the basic sciences and the application of them to man's welfare. Urging on the part of industrial leaders has aroused an interest on the part of educators to broaden the curriculum base to include subjects essential to management functions.

Training for Management

But the question of adequacy keeps recurring—i.e., is the engineer sufficiently well rounded in his knowledge of all the company operations? What must he add to his engineering knowledge and experience to become a manager in an industrial organization? These are some of the additional areas in which he must become proficient:

- Motivation of the individual
- Delegation of responsibility and authority
- Decision-making
- Setting an example or leading
- Exercising business judgment
- Corporation finance
- Improving own capacity
- Formulating and achieving the company's overall objectives
- Co-ordinating functions and people

In progressing from an engineering position to a management position there is time to acquire this training. Training needed is composed of formal study and experience. The formal study can be obtained in several ways. To list a few: At college evening classes; at seminars as given by management associations; and in training programs at colleges which run from a few days to a few weeks in duration.

Experience can be acquired: (*a*) Through day-to-day assignments in business life; (*b*) through committee work in civic organizations; and (*c*) through officer and committee work in engineering societies, trade associations, and similar bodies.

Fortunately, the engineer who is creative and has a receptive mind will be singled out rather early through evidence of his desire to grow into more responsible management positions. Such a mental attitude finds assistance in courses such as the following: Effective speaking and writing; accounting; human engineering; contract law or logic; insurance and taxes; industrial relations; public relations; sales methods and incentives; and advertising.

In our company formal study is encouraged. Evening schools offer a wide range of subjects—in fact, so comprehensive almost any need can be satisfied. We also have under consideration a management development program for our key people. This would mean having instructors from a local college, who are especially trained to present such material, work with us in developing a program. Our objectives would be:

1 To develop more clearly in the minds of our key people an awareness of what is expected of them in performing their jobs.

Chairman's Corner

THE National Junior Committee (NJC) requests your ideas and participation. NJC has as its objective the development and encouragement of young engineers. Use the Junior Forum to foster your ideas and call on the Junior Committees, National, Regional, or Local, to assist also.

In letters and a recent survey many young engineers have shown an interest to take a more active part in professional activities and have expressed a desire to learn more about ECPD and EJC. The following list of informative and authoritative pamphlets may be ordered from ECPD, 29 West 39th Street, New York 18, N. Y.

1 Proceedings Joint Assembly of 25th ECPD annual meeting and 4th EJC general assembly, Oct. 24–25, 1957, 52 pp., $1.50.

2 Summary of a Study for ECPD of the Qualification Procedure in the Fields of Accounting, Architecture, Law, and Medicine, 15 cents.

3 The First Five Years of Professional Development (ECPD Training Committee), 1951, 160 pp., $3; 4-page brochure, 10 cents.

4 25th ECPD Annual Report, Sept. 30, 1957, $1.

William V. Chambers, chairman, National Junior Committee, ASME

[1] Development engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.

[2] Based on an address presented at the 25th Annual Meeting of ECPD and 4th General Assembly of EJC, Oct. 24–25, 1957, New York, N. Y., and published in the Proceedings Joint Assembly of that meeting.

[3] President, Yarnall-Waring Company, Philadelphia, Pa. Fellow ASME.

2 To develop the managerial skills of these same people.

This program would enable managers and supervisors to do their present jobs better, to develop themselves for the assumption of greater responsibility, and to build a stronger and more cohesive team effort.

But, can we allow our engineers to enter the halls where business philosophies are determined?

The professional engineer is known for his ability to think precisely, accurately, and imaginatively. But to these basically essential skills the engineer must add additional skills and techniques to qualify as a manager.

Essentials for Management Functions

Finance is not foreign to an engineer. Finance is mathematics dressed up in a different suit. Established forms must be observed, and the significance of interpretations must be known, as they are vital in company plans. The engineer must find a way to become "at home" in finance, just as he must be at ease when "welding" an organization together personnel-wise.

Assigning of responsibility is paramount as a management requirement. It is difficult for engineers to do this, as so many engineered products in a small business are the result of the efforts of a single individual. The engineer in management must separate himself from this restriction and find the way to share responsibilities. In addition, as a good manager he must weave into the spirit of the organization a desire to do things well.

And now let us turn to an authority concerning the reasoning process of an engineer. Carl W. Muhlenbruch, of Educational and Technical Consultants, Inc., succinctly states truths pertinent to our subject:

"The average engineer graduate is well trained in the *deductive* reasoning process. He can organize problems and formulate plans for their solution. He lacks skill in doing this in the human relations, economics legal, and other business areas, but these skills can be developed. The important thing is that he is well trained in the reasoning process. A fortunate few engineering graduates are able to escape the learning process with a goodly amount of *inductive* reasoning because they possess the very fortunate skill of being able to anticipate problems. They then go on to formulate solutions to the problems and thus are able to work more efficiently at the executive function."

The engineer-manager finds satisfaction and a better balanced confidence in a knowledge of the social sciences, the understanding and practice of which aids in creating an atmosphere of wholesome co-operation. Associates find the more highly developed ethical appreciation a healthier influence in realizing growth potential. The individual in turn realizes relief from ulcer torment and a more useful place in society.

And this place that the engineer is finding so fruitful can be his hallmark if he alerts himself to the social, political, and economic trends. A broad, new, and challenging avenue has been opened for him to attain more truly the full measure and meaning of the professional man.

ASME CODES AND STANDARDS WORKSHOP

Test Code for Diesel and Burner Fuels Published

By Ralph A. Sherman
Chairman of PTC Committee No. 3

THOSE concerned with the purchase and utilization of liquid fuels in heat generation and in diesel engines should welcome the Test Code for Diesel and Burner Fuels that has just been issued by The American Society of Mechanical Engineers. In 84 pages, under one cover, the code contains methods for the collection of the sample and for the determination of all of those physical and chemical properties pertinent as indicators of the value of liquid fuels when used in equipment for the generation of heat or of power. Excluded only are gasoline or other fuels used in spark-ignition engines.

Most of the standards adopted are those formulated by Committee D-2 on Petroleum Products and Lubricants of the American Society for Testing Materials. Some are standard Naval Boiler Testing Laboratory Methods. All of these have been carefully reviewed and revised where desirable with the addition of pertinent supplementary material or the omission of that considered irrelevant. A feature that should be particularly helpful is the introduction of each test method by a brief discussion of the significance of the test.

The new test code was prepared by Power Test Code Committee No. 3 on Fuels. It has been reviewed and approved by the standing Power Test Codes Committee. The code was approved and adopted by the Council as a standard practice of the Society by action of the Board on Codes and Standards on Jan. 29, 1957.

New Power Test Code for Deaerators

By P. H. Hardie
Chairman of PTC Committee No. 12

ABOUT a decade ago there was some question as to the need for an ASME Power Test Code for Deaerators. This was due to a swing in power-plant-design practice to the utilization of a deaerating section in the main condenser, instead of a separate deaerator and storage-tank feeding the suction of the boiler-feed pumps. Anticipated savings in plant-investment cost have not been attained due to added complications, nor have the plants with condenser deaeration been free from corrosion due to oxygen residual in the condensate and feedwater.

Today a separate deaerator is almost universally considered advisable, hence the need for an ASME standard procedure for testing its performance. Such a code has been prepared by PTC Technical Committee No. 12 on Condensers, Feedwater Heaters, and Deaerators, approved by the Council of the Society through action of the Board on Codes and Standards, and will be published soon.

In the preparation of this test code the

committee has made use of other standards such as the ASTM D 888-49T, "Methods of Testing for Dissolved Oxygen in Industrial Water," and the HEI "Standard Methods and Procedures for Determination of Dissolved Oxygen." The new test code is in substantial agreement with them. The test procedure for determining thermal performance also is covered in this code.

The members of PTC Committee No. 12 are: P. H. Hardie, chairman, Ebasco Services, Incorporated; C. E. Brune, American Gas and Electric Service Corporation; D. C. Carmichael, E. I. du Pont de Nemours & Company, Inc.; J. J. Finnegan, Niagara Mohawk Power Corporation; J. F. Grace, Worthington Corporation; G. T. Hutchison, Cochrane Corporation; E. L. Knoedler, Sheppard T. Powell; F. A. Morrison, Elliott Company; M. A. Nelson, Westinghouse Electric Corporation; J. F. Sebald, Worthington Corporation; H. G. Wenig, Bulova Research and Development Laboratories, Inc.; and J. D. Yoder (retired), The Permutit Company.

ASME Power Test Code for Atmospheric Water-Cooling Equipment

By Joseph Lichtenstein
Chairman of PTC Committee No. 23

After many years of preparation the new ASME Test Code for Atmospheric Water-Cooling Equipment finally has been published. The Code stresses utmost simplicity in its content and is designed to serve as a guide to the field engineer during testing. This attitude represents a departure from other test codes where weight is given toward a theoretical justification of the methods recommended.

The first draft of this code followed this earlier attitude but criticisms both of users and manufacturers established the newer trend in code writing and necessitated the organization of a subcommittee with the sole task of condensing and simplifying the first draft. The code as it appears now is the result.

The simplicity of this code requires little comment with the exception possibly of two points that deserve some consideration.

The first is the character of the equipment covered by this code which differs from the equipment covered by other test codes in that the conditions of performance on which the guarantee is based cannot be duplicated at will or held constant during the test. In addition, simple analytic expressions which would permit the reduction of the test conditions to guarantees are not available.

These facts alone are sufficient to make acceptance tests, based on a single set of guaranteed conditions, practically impossible. The code circumvents this difficulty by expanding the guarantee from a point, representing a single set of cooling conditions to a limited zone in which each point represents a different set of performance conditions. Each set of conditions is considered of equal standing. If the acceptance test proves the meeting of performance for one set of conditions contained within the limited zone, it is accepted that the equipment is meeting performance for all other sets which, of course, includes the specified set of the contract.

The introduction of the limited guarantee zone makes testing of atmospheric water-cooling equipment possible within a reasonable part of the year and eliminates the necessity of reducing tests to guaranteed conditions. It simply substitutes the manufacturer's experimental data which the limited zone represents. Any differences in such data between manufacturers can be given proper weight at the time when the equipment is purchased.

The second point which deserves comment concerns the absence of any mention of recirculation in this code. This in spite of the fact that of all environmental influences, recirculation can affect the performance most severely. If recirculation were purely a manifestation of the environment, it would have to be considered in the test code. However, design plays an equal if not more important role and, theoretically at least, certain designs could suppress it entirely.

A separation of the two influences, environment and design, proved to be impossible. It became clear that eliminating recirculation from the guarantee would give a license to the worst design. The manufacturers themselves then proposed to accept recirculation as part of their responsibility. This is accomplished in the code by specifying that wet-bulb temperatures shall be measured on the windward side, 50 ft away from the tower. As a consequence the tower is, so to speak, extended to include a boundary space of 50-ft radius. Recirculation which takes place within the boundary space becomes an internal process and its effect on performance is reflected in the over-all test results. Of course, the boundary space is supposed to be kept free of obstructions to air flow or of any equipment discharging heat or moisture.

The character of atmospheric water-cooling equipment, the inability to test it under controlled laboratory conditions, not too well defined effects of environment on its performance, invite lengthy theoretical discussions which, however, were finally eliminated in favor of a single code designed to accomplish a practical purpose. It is hoped that the test code will contribute toward reaching the essential goal for which atmospheric water-cooling equipment is installed in industry, namely to provide the cold water temperature specified.

Pamphlet copies of the codes may be ordered, separately or together, from: Order Department, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y. Prices are: Diesel and Burner Fuels $4; Deaerator Code, $3; Atmospheric Water-Cooling Equipment Code, $2.75.

Microscope Objective Thread Standard Published

American Standard Microscope Objective Thread, B1.11-1958, has been published by the Society and copies are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. A new standard, this is the result of work begun in the Ottawa 1945 Conference on Unification of Engineering Standards, and represents a unified thread among United States, Great Britain, and Canada.

The thread is not a fastener thread but a positioning one, for use in microscope objectives. Since American optical industries followed Royal Microscopical Society practices in setting their own, this thread has the peculiarity of being the only American Standard thread of British Whitworth form.

Machine Pins Revision, Brass or Bronze Screwed Fittings Revision Published

American Standard Machine Pins, Including Dowel, Taper, Cleavis, Grooved, and Cotter Pins, B5.50-1958, and American Standard Brass or Bronze Screwed Fittings (125 lb), B16.15-1958, have been approved and are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Both are revisions of previous standards.

Drafting Standard on Gears, Splines, and Serrations Approved

By Harry H. Gotberg
Chairman, Y14 Subcommittee 7

Drafting Practice for Gears, Splines, and Serrations, Section 7 of the Y14 Drafting Standards Manual, has been approved by the American Standards Association, and copies are expected to be available by the end of May.

The old "one-paragraph" standard contained in Z14.1-1945 is expanded to

conform to the modern techniques of specifying gears so that the gear manufacturers will have more detailed information concerning the quality of product that the user needs or desires. Although the standard is not intended to be a textbook on gear design, the new standard does give reasons for the methods shown and specified so that the user of the standard will have some basic understanding of the need for more detailed gear-tooth dimensioning and specification. This is in keeping with the existing related standards on the subject of gearing now available as ASA B6.1-1932, B6.8-1950, B6.10-1954, and B6.11-1956.

Also, the new Y14 Section 7 includes the delineation and specification of splines and serrations, which are now subjects closely related to gearing. The spline and serration portions also conform to the present ASA B5.15-1950. This latter standard is now being revised and will include inspection procedure. A major portion of this revision is available for industry comment. (See March, 1958, "ASME Codes and Standards Workshop," page 150.)

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Administrative Assistant, BS in Administrative Engineering (Mechanical); 31; total nine and one-half years production engineering including five years supervision 50-person staff for metal-parts manufacturing and development, including quality control, finishing, handling. Experienced purchasing, processing, performance. Full responsibility. Prefers vicinity Buffalo, N. Y. Me-553.

Executive Engineer, BME; 36; 12 years of engineering supervision from project direction to chief engineer in electromechanical and electronic equipment and instrumentation for rocket testing and meteorological research. Heavy military program experience. Prefers metropolitan New York area. Me-554.

Industrial, Production, Manufacturing, Process, or Planning Engineer, BSME; 39; registered PE, Ill.; five years' experience in planning, metal processing, and production control with farm-tractor manufacturing company; one year's experience in tool design and plant engineering with plastic company; three years' design experience with heavy earthmoving-equipment manufacturing company. Prefers Midwest. Me-555-874-Chicago.

Industrial Engineer, BSME; 34; nine years' varied experience in methods and time study, incentives, standard costs, standard data, building design, plant layout, machine design, and estimating. Prefers Midwest. Me-556-9593-Detroit.

Nuclear Manager, BSME; 30; ten years in mechanical and electromechanical nuclear project engineering and sales promotion. Experienced administrator seeks company to diversify its business profitably into the nuclear field. Prefers East. Me-557.

Mechanical Engineer, Research and Development, BS (ME major); 28; five years research and development in process equipment. Design and development work in mechanical devices. Special emphasis in fields of fluid flow (air handling) and heat transfer. Prefers East. Me-558.

Mechanical Engineer, BSME; 35; registered N. Y.; nine years' background electrical products including air conditioning in design, quality evaluation, tests, and specifications; also purchasing, accounting, seeks management position, medium-size company. Prefers Midwest or N. J. Me-559.

Chief Engineer, BSME, MSME; 35; diversified background; 12 years' experience—industrial machinery, power, and propulsion. Applied research, development, design, administration. Ideally suited for overseas position. Location immaterial. Me-560.

Plant Engineer, BSME; 27; two years' plant engineering including plant layout, installation of new equipment, material handling, and general plant-engineering experience, heavy industry. Prefers East. Me-561.

Management Engineer, BSME, BS Bus. Adm., ML Ind. and Economics; 31; eight years' experience in methods engineering, manufacturing engineering, time and motion analysis, labor standards, grievance procedures, facilities planning, design engineering, cost and expense reduction, first-line supervision and general supervision of manufacturing operations, management of engineering design and development. Prefers university town; any location. Me-562.

Hydraulics Engineer, BSME; 38; 15 years in design, development, maintenance of hydraulic systems and components, and administration of engineering programs. No preference as to location. Me-563.

Sales Engineer, BME, heat power; 30; structural design and supervision, environmental testing, vibrations (analytical and empirical), applied dynamics in turbines, field engineering and diverse sales (five years' experience). Prefers home office in New York City or N. J.; 50 per cent travel. Me-564.

Railroad Mechanical Officer, BSEE; 32; ten years' experience in all phases of railroad mechanical work. Able to handle wide variety of supervisory positions, especially qualified to plan and direct maintenance program. Registered engineer, Ga. and Ill. Prefers South or East. Me-565-867-Chicago.

Design and Development Engineer, BS (Eng.), London; 29; seven years' postgraduate industrial experience plus formal apprenticeship. Recent industrial heating-equipment design. Previous development of small electromechanisms. British citizen. Prefers New England. Me-566-9648-Detroit.

Industrial-Mechanical Engineer, BSAdE; 31; four and one-half years' experience, currently employed metalworking industry, executive level. Activities include: methods, materials handling, plant layout, time study, special handling and production-equipment design and development, cost reduction, costing, special projects, trouble shooting. Prefers Greater New York metropolitan area. Me-567.

Chief Manufacturing Engineer; 50; 30 years' manufacturing and engineering experience in the automotive, aircraft, radio, and refrigerator industries; qualified to be of service to employers seeking to reduce manufacturing costs. Prefers any location except South. Me-568.

Engineering Manager, BAeroE; 39; five years' automotive product design, development, and project management; four years teaching thermodynamics, gas turbines, fluid and solid mechanics; ten years administrative and supervisory experience. Foreign languages. Relocate in U. S. or abroad. Me-569-9628-Detroit.

Professor of Mechanical Engineering, MS and ME; 65; teaching internal-combustion engines, thermodynamics, and heat power, 21 years. Industrial research supervisory automotive fuels and engines, 16 years. Location immaterial. Me-570-9623-Detroit.

Design Engineer, BSME; 26; two years' design and plant engineering for a chemical plant; two years' industrial engineering in the U. S. Air Force; one year miscellaneous design. Prefers West or Europe. Me-571-San Francisco.

Combustion Engineer, BSME; 30; four years' experience as combustion engineer for large container manufacturer; four years' experience with steel mill as mechanical maintenance foreman and student engineer. Prefers Chicago area. Me-572-877-Chicago.

Mechanical Engineer; 44; diversified experience including plant engineering, oil processing, penstocks, and the full range of construction activity. Past engagements demanded highest application of skills and ability. Interested in foreign assignments. Me-573.

Positions Available

Teaching Personnel, Instructors to Associate Professor, graduate mechanical, to teach heat and power and industrial engineering. Rank will be determined by qualifications. Appointment for September, 1958. $4500-$6000 for nine months. Ohio. W-5711-C-6766.

Teaching Personnel, Department of Mechanical Engineering. (*a*) Instructor or assistant professor in engineering graphics and drawing. Instructorship will carry privilege of fulfilling requirements for master's degree at the rate of up to three courses a year. (*b*) Assistant professor or associate professor interested in teaching kinematics, mechanics of machines and machine design. Master's degree required, experience in these topics desirable. (*a*) $5000-$6000; (*b*) $6000-$7000 for academic year. Available Sept. 1, 1958. Upstate N. Y. W-5900.

Instructors or Assistant Professors, to teach applied mechanics, strength of materials, mechanisms, mechanical-engineering laboratory, or heat-power courses. Opportunity to work for master's degree. Rank and salary dependent upon experience and education. Available September, 1958. New England. W-5904.

Development Engineer, Air Filters, preferably graduate mechanical, young, at least two years' experience in development or design work, preferably with air filters or closely allied products;

[1] All men listed hold some form of ASME membership.

aptitude for and interest in independent development work with a minimum of supervision. Will act as project engineer on various air-filter development programs; assist technical director as technical adviser to sales and manufacturing departments, etc. $6500. Upstate N. Y. W-5912.

Assistant to General Manager, experience in a machine-jobbing shop specializing in precision machining of metal castings on jig borers, horizontal boring mills, milling machines, lathes, grinders, drill press, etc. Should have background that will enable applicant to take complete charge of the plant, estimating, sales engineering, and other functions. Approximately $10,000–$12,000. Vicinity of Newark, N. J. W-5913.

Senior Design Engineer, qualified to design and follow up the performance of printing presses especially for carton board stock; select and install automatic machines to fabricate and fill packages; follow up performance and design improvements; direct design of light-duty automatic machinery for product manufacturer. Technical training, suitable actual experience and definite leadership qualifications are required. Salary open. Midwest. W-5919.

Chief Engineer. Must be good manager and administrator, for large multiplant manufacturer of automotive equipment and parts. Must be able to deal with clients such as Ford, GM, or Chrysler, and develop programs for new products, etc. $15,000, plus. Midwest. W-5927.

Director of Engineering, to 50, graduate mechanical, advanced degrees, competent to direct several engineering departments in product development and manufacturing engineering involving heaviest mechanical equipment and processes, and heavy ordnance and defense products. Must have demonstrated administrative ability in large engineering organizations. $30,000–$35,000. New York, N. Y. W-5935.

Director of Industrial Engineering, to 45, graduate mechanical or industrial engineer, experience in very heavy industry including steel fabrication, foundry and machine shops, storage and handling of heavy steel shapes and plates, plant layout, and normal industrial-engineering functions. Must be competent to administer industrial engineering for multiplant operations employing over 30,000. To $25,000. East. W-5937.

Development and Design Engineer, graduate mechanical, at least ten years' experience in the metal-cutting industry. Must have ability to design and lay out various types of machine tools; must be thoroughly familiar with all phases of machine design and have knowledge of hydraulic, electrical design, and automatic control. Conn. W-5945.

Design Engineers, mechanical graduates, minimum of five years' experience in the design of high-speed precision assembly equipment. Mechanical inventiveness of high order required. Must be capable of board work as well as the follow-through of supervising the fabrication of a piece of assembly equipment. $12,000 to start. Central N. J. W-5954.

Assistant or Associate Professor, MS or PhD required, to teach graduate and undergraduate thermodynamics and fluid mechanics. Teaching or research experience highly desirable. Salary dependent upon qualifications. Midwest. W-5955.

Assistant or Associate Professor of Industrial Engineering, preferably PhD but will consider MS. Will take charge of curriculum in industrial engineering. Available September, 1958. New England. W-5956.

Senior Project Engineer, BSME, or at least two years' college education or equivalent, with practical experience in machine-shop work, to supervise, both directly and through others, specific designs, programs, or projects related to shop layout, machinery, and equipment, including tools, dies, jigs, etc., to follow through to completion and place into operation assignments as may be assigned through plant engineer, assist in engineering studies related to or required by programs involving major or long-range renovation of facilities, etc. $7872–$9288. Pa. W-5963.

District Industrial Engineer, BS or MS degree in industrial or mechanical engineering, with five years' industrial-engineering experience including two years in a supervisory capacity. Extensive experience in methods engineering, materials handling, time study, wage incentive, and job evaluation. Three-year contract with transportation both ways and salary while traveling. South America. F-5973(*a*).

Plant-Design Engineer, mechanical or civil graduate, at least five years' stress-analysis experience on power and process equipment, to

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐ _____

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER: e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐ _____

HOME ADDRESS _____ City _____ Zone _____ State _____

☐ _____

PRIOR HOME ADDRESS _____ City _____ Zone _____ State _____

* CHECK "FOR MAIL" ADDRESS

Address changes effective when received prior to:

I subscribe to

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

supervise design and analysis of equipment, structures, piping, and foundations. $9000. Conn. W-5979.

Plant Engineers, mechanical, not over 30, preferably with three to five years' experience in maintenance, installation of chemical-process equipment, utilities and new construction, chemical plant. $6000-$8000 Conn., Ind., and New York, N. Y. W-5980.

Mechanical Designer, preferably graduate mechanical, to 40, eight years in design of heavy machinery such as locomotives, heavy ordnance, industrial railroad cars, earthmovers, steel mill materials-handling machines, etc. Design experience in at least two of three categories in following order of importance: (1) weldments, (2) steel castings, (3) gearing. Should be familiar with inspection methods. Salary open. New York, N. Y. W-5988.

Plant Engineer, BS (ME), young, at least two years' experience in plant engineering in cement or rock-products industry. $7000–$8000. Eastern Pa. W-5994.

Administrator of Products Engineering, 35 to early 50's, graduate mechanical or electrical engineer, ten to 20 years' experience. Previous power experience helpful. Knowledge of sales also helpful. Company manufacturers pole-line hardware and hand-construction tools, anchors, hot-line tools, tap clamps, electric connectors, switchgear, cutouts and fuse links, etc. Should have good ideas for improvement of present products as well as ability to develop new products. To $30,000. Mo. W-5995.

Teaching Personnel, Department of Mechanical Engineering, for ECPD approved college, preferably under 35, master's degree in either mechanical or aeronautical engineering, preferably both teaching and professional experience in mechanical engineering. $4800–$8400, nine months' teaching. Salary and rank commensurate with educational and professional experience. Gulf Coast. W-6009.

Industrial Engineer, Phosphate Mining Division, BS industrial-engineering major, minimum of two years' experience. Will devise and maintain methods and procedures necessary to control material and labor cost; set up production-cost records and control systems; set up program of preventative maintenance and repair; analyze need for and use of mobile equipment; devise inventory and purchasing controls. $6500-$7200. South. W-6018.

Manager of Mechanical Development, graduate, ten to 15 years' experience in the machine-tool industry, particularly on grinding or turning machines. Good background and knowledge of electrical and mechanical gaging equipment, both domestic and foreign tools. Salary open. Pa. W-6022.

Plant Engineer, mechanical or civil-engineering degree, 26-35, three to eight years preferably in materials-handling and equipment-layout work, for designing and drawing of equipment and small steel structures in food processing plant. $8000. W-6029.

Supervisor, Standards Department, 30–45, IE or ME graduate, experience in supervising a standards department and a knowledge of the metal-fabricating industry, to take charge of standards department and supervise daily operations of incentive systems in plant, installation of standard data program, work on cost-reduction programs and closely with product-processing groups, and will make surveys as to high labor-cost areas. Approximately $9000. Pa. W-6031.

Senior Industrial Engineer, 40–45, IE graduate, at least ten years' supervisory staff and line experience covering budgets, costs, estimates, production, and plant layout in food processing and packaging. $15,000. New York metropolitan area. W-6040.

Engineers. (*a*) Project engineer, aircraft hydraulics, 30-40, graduate mechanical or aeronautical, ten to 12 years' engineering experience, eight to ten years on aircraft engines or similar products including engines. Experience should be concentrated primarily on small-size, high-speed, precision products, or mechanical devices, and should include four years of actual design work. Stress on creative design. $9000–$10,800. (*b*) Design engineers, mechanical or aeronautical, for aircraft hydraulic design; three to four years' experience in layout-design work in hydraulics, aircraft engines, or related products. $6600–$8400. Northern N. J. W-6043.

Sales Personnel. (*a*) General sales manager, graduate mechanical or equivalent, 35-45, strong in administrative ability. Must have successfully handled all facets of a complete industrial sales organization. Should be presently assistant general sales manager or general sales manager of company producing industrial blowers, rotary gas pumps, rotary gas meters, and/or rotating equipment for the positive movement of air, gas, or steam turbines, large industrial compressors, etc. $20,000–$30,000. (*b*) Field sales engineer, engineering degree or equivalent, 28-40, three to four years' industrial selling along equipment line sales. Must be able to make necessary technical computations to satisfy customer demands and insure proper application of equipment. Engineering calculations necessary to select the machine, driver, and accessories. Four to six months' training and four to six months in field prior to account assignment. $6500–$8500. Midwest. W-6044.

Project-Design Engineer, graduate mechanical or equivalent, 25–35, four to five years' design experience on industrial multistage blowers or in lieu of actual blower experience would consider steam-turbine design experience. Must be interested in and have a desire to continuously perform design work. $6000–$7800. Midwest. W-6045.

Industrial Engineer, graduate of recognized school of industrial or management engineering, two or maximum of three years' experience in time-study and methods work. This experience in maintenance-type activity would be desirable. Plant layout, process analysis, etc., desirable. $7200. East Coast. W-6051.

Sales Engineer, 25-35, BSME, with three to five years in design and development of electromechanical instruments using precision ball bearings or three to five years as a sales engineer handling precision or electromechanical instruments. Some travel necessary. Salary and commission. Headquarters, Long Island, N. Y. W-6052.

Designer, Supervisory, machinery and equipment, graduate mechanical, 30-40, five to 15 years' design and supervisory experience with companies manufacturing machinery and equipment mechanisms (preferably related to press operation), power transmissions (hydraulic cycles, valves, pumps, electric drives, electric, or hydraulic controls), able to deal with auxiliary equipment (steam and electric heaters, pneumatics, and water cooling); able to design auxiliary tooling for special application; knowledge large dies and tools, and general molding process. Take charge of a department for large manufacturer. $9000–$12,000. Stockton-Sacramento, Calif., area. S-3469.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after May 23, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

BENES, PETER, Mobile
MILLER, RAYMOND O., Mobile
PURDY, EVANS L., Mobile

Arizona

BUCKNER, HOWARD A., JR., Scottsdale

Arkansas

JOHNSON, LELAND B., Hot Springs

California

BAKER, FRANCIS P., Alhambra
BOYNTON, WILLIAM W., La Canada
CHRIST, FREDERICK C., Long Beach
• DEGNER, VERNON R., San Fernando
HOLMES, FRANK R., Brea
JOYCE, ALLEN R., Los Angeles
LINGO, ALFRED A., Riverside
MASHETER, WILBUR L., Los Angeles
MEYER, JAMES B., JR., Sherman Oaks
NONAMAKER, JAMES N., Monrovia
NOWELL, ROWLAND H., North Hollywood
OWENS, GEORGE R., Fullerton

Connecticut

BLOCH, PETER K., Stamford
• CHANOUX, THEODORE, Bridgeport
• D'AMICO, ANTHONY F., South Norwalk
HABER, HARRY S., Broad Brook
KELEMENCKY, MONROE R., Stepney
LINDMARK, ANDREW C., Bridgeport
LOEFFLER, ROBERT D., Simsbury
PERLA, MARTIN R., Fairfield
SEDERQUIST, CARL E., Wethersfield

Delaware

BROWN, RICHARD B., Newark

Florida

GOLAN, RICHARD L., Pensacola
GOODLING, DONALD L., Atlantic Beach
HARDING, FRANCIS, Pensacola
• MORRISON, HOWARD A., Warrington
RUF, WALTER, Pensacola
STONE, LOUIS E., Winter Park

Georgia

GRIMES, WILLIAM B., Savannah

Illinois

ANDERSON, GORDON R., Chicago
BLACK, HAROLD J., Springfield
FLETCHER, DONALD R., Lombard
JAEGER, BEN E., Plano
KAHLENBERG, ALBERT H., Elmhurst
• MCCAULEY, EDWARD D., Chicago
RADTKE, CHARLES M., Chicago
ROGERS, MURRAY H., Park Ridge
STOCK, BERNARD J., Chicago
VAN METER, ARCHIE W., Metropolis

• Transfer to Member or Affiliate.

Indiana

BARTLE, RICHARD S., Lafayette
• COLLINS, SEYMOUR, Richmond
• IRELAND, ROBERT G., Indianapolis
RUSHTON, JAMES F., Mishawaka
SCHAHFER, ROLLIN M., Hammond
TRIPP, WILLIAM B., Connersville

Kansas

CARLSON, WARREN O., Overland Park
MILLER, HERBERT H., Paducah

Louisiana

GRUSH, ROBERT J., New Orleans

Maryland

DEMARE, BALTZAR L., Aberdeen

Massachusetts

MANN, ROBERT W., Cambridge
PETERRIT, LOTHAR H., Worcester
SIBURIN, DONALD, Worcester

Michigan

LUDEMA, KENNETH C., Ann Arbor
SOKOLOFF, ALEXIS N., Port Huron
• WRIGHT, EDWARD A., Allen Park
• YAEGER, RAYMOND G., Warren

Minnesota

BARTON, ARTHUR M., Minneapolis
FORTHUN, MELVIN L., La Crescent

Missouri

NEIHEISER, CHARLES L., Cape Girardeau
PRITCHETT, HAROLD R., Kansas City
• SCOFIELD, GORDON L., Rolla

Nebraska

BROMAN, DONALD E., Lincoln

New Jersey

ANDRUS, JOHN R., Clark
BUTTA, PHILIP J., Gilette
DOLAN, JOHN E., Maywood
ECKSTEIN, WARREN T., Woodbury
• FEIN, MONROE S., West Orange
GOREN, MARVIN, Verona
IMMING, HARRY S., Westfield
KOSOWSKI, LEON L., Trenton
KRAPCHO, FRED, Atlantic City
RICHARDS, DENNIS, New Brunswick
STRUZYNA, GEORGE A., Westfield

New Mexico

CZERNER, RICHARD R., Albuquerque
HEWITT, WALTER D., Albuquerque

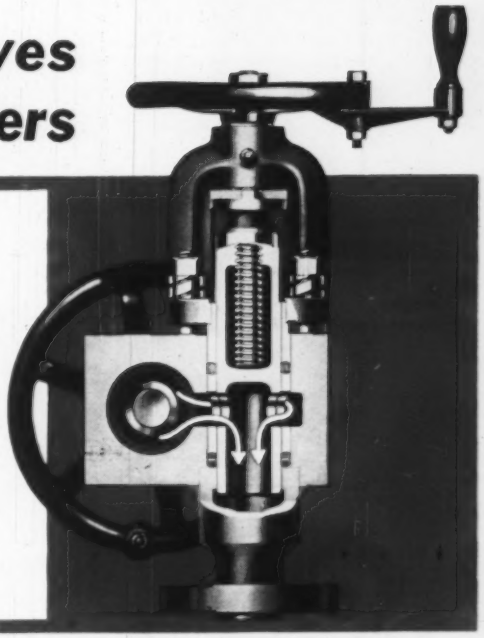
New York

BALOGH, RICHARD L., Corning
BENNETT, GERALD W., Bluepoint, L. I.
BOGEMA, MARVIN, Ithaca
CLARK, VAUGHN C., Oswego
DIAMOND, NORMAN, Elmont, L. I.

(*ASME News continued on page 152*)

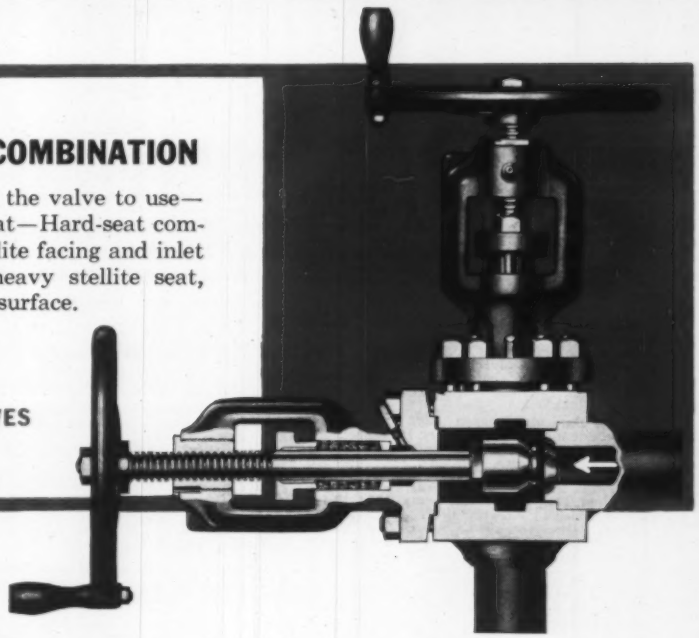
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **BLOW-OFF VALVES**

DURBECK, ROBERT C., Poughkeepsie
FLYNN, JOHN J., JR., Bayside
GORDON, DONALD H., Huntington, L. I.
GREINER, JOSEPH E., Rochester
JACOBSEN, FINN R., New York
LOVETT, HOWARD E., New York
LUBITZ, STUART, Kingston
NEVINSKAS, ALFRED J., Webster
● PECHSTEIN, RICHARD H., Valley Stream
PINKUS, ALAN, Bay Shore
REYES, SALVADOR V. R., New York
SOLLECITO, PETER, Brooklyn
● STERN, ABRAHAM I., Franklin Square, L. I.
THORKILDSEN, ROLF L., Schenectady
TROHA, WILLIAM G., Lynbrook
TULLY, JOHN C., Clinton
WILKLOW, THEODORE L., Sidney

North Carolina

YOUNKER, BARR D., Seymour Johnson AFB

Ohio

BLEVINS, JAMES G., Cincinnati
RITTER, JOHN A., Cincinnati
SEARCH, STACY M., Cincinnati
SETZLER, PAUL H., Barberton
STUIVER, WILLEM, Cincinnati

Oklahoma

● BEASON, ELMER C., JR., Bartlesville
BRAUSER, STANLEY O., Stillwater
PRYOR, ROBERT C., Bartlesville

Oregon

YOUNIE, JOHN W., St. Helens

Pennsylvania

BARLOW, RONALD E., Malvern
CONNORS, HERMAN J., Pittsburgh
COUPERUS, PIERCE G., Glenside
● DITARANTO, ROCCO A., Philadelphia
ELLIS, SYDNEY M., Erie
ENGEL, MARVIN J., Philadelphia
EPPERT, TRUMAN V., E. Pittsburgh
GADDIS, HARRY L., Butler
HALL, ERNEST P., Pittsburgh
LULI, WILLARD A., Grove City
MACHONIS, WILLIAM F., Philadelphia
MACLEOD, DONALD R., Erie
MATHER, ROGER F., Pittsburgh
MCLEAN, HOWARD J., Erie
MEGRONIGLE, CHARLES K., Springfield
MONTANARI, FRED W., Greensburg
PRAGER, PHILIP C., Swarthmore
SMITH, JOHN R., Pittsburgh
SYSKA, JEDRZEJ, Meadville

Rhode Island

GUIORGUIEV, METHODI P., Riverside

South Carolina

HENDRIX, WALTER H., Camden

Tennessee

DOUGLASS, NELSON L., JR., Oak Ridge

Texas

HOLLINGSHEAD, CECIL I., Baytown
HOWELL, HOLLAND, Texas City
LOGAN, EARL, JR., College Station
NICHOLLS, PAUL E., JR., Houston
STROUD, ALLEN J., Texas City
TINSLEY, JAMES S., Houston
VICKERS, BOYD J., Orange
WORTH, RICHARD F., Baytown

Virginia

NIX, WILLIE L., Hampton
● PURCELL, RAYMOND E., Staunton

Washington

● FREESE, LEONARD B., Vancouver
MALIN, VINCENT O., Tacoma

West Virginia

BOESCH, JOHN C., JR., South Charleston
MUEHLMAN, RAYMOND L., Charleston
PESCHL, FRANK C., New Martinsville

Wisconsin

MAERSCH, ROBERT E., Milwaukee
MARDEN, EARLE R., JR., La Crosse

Foreign

BOYD, ALEXANDER, Toronto, Ont., Canada
EL DAKHAKHNI, MEDHAT B., London, England
GAITAN, LUIS J., Havana, Cuba
MEADOWS, RONALD H., Toronto, Ont., Canada
NAIR, K. P., Gopinath, Munich, West Germany
PAWSON, GEORGE, Stockton-on-Tees, England
REBENTISCH, JOHN A., Oahu, T. H.
RUITER, JOHANNES L., Calgary, Alb., Canada
STERLING, WILSON G., Edmonton, Alb., Canada
SUBRAMANIAM, JOSEPH J., Amparai, Ceylon

OBITUARIES

Edward E. Ashley, Jr. (1883–1958), senior member of the firm of Edward E. Ashley, consulting engineers, New York, Washington, and Amsterdam in the Netherlands, died Feb. 3, 1958. Born, New York, N. Y., Oct. 1, 1883. Education, attended Cooper Union and Cornell University. Married Beulah Watson. Jun. ASME, 1910; Assoc-Mem. ASME, 1914; Mem. ASME, 1916. Before World War I, he held positions with the Thompson-Starrett Co., Lincoln Engineering Co., and Starrett and Van Vleck. During World War I, as a major with the construction division of the Army Signal Corps, he was associated with the development of military flying fields. He founded his own firm in 1932. Mr. Ashley was a member of many organizations and had for many years been chairman of the Darien Water and Sewer Commission. Survived by his widow and two sons, Edward E. Ashley, 3rd, Arlington, Va., and Austin S. Ashley, Sudbury, Mass.

Leonard Kenneth Botteron (1902–1956), design engineer, Copes-Vulcan Division, Blaw Knox Co., East Chicago, Ind., died Nov. 1, 1956. Born, Fort Wayne, Ind., Aug. 22, 1902. Education, BS(ME), Purdue University, 1924. Mem. ASME, 1954. Mr. Botteron had been the author of several articles in technical publications. He held several patents pertaining to locomotives. Survived by his widow.

Max H. C. Brombacher (1884–1957), retired chief engineer, Florida East Coast Hotel Co., Palm Beach, Fla., died Aug. 28, 1957. Born, Brooklyn, N. Y., March 7, 1884. Education, ME, Columbia University, 1904. Mem. ASME, 1921.

Carlos Emerson Bronson (1886–1958), former vice-president and chief engineer, Kewanee Boiler Division, American Radiator and Standard Sanitary Corp., Kewanee, Ill., died Jan. 21, 1958. Born, Painted Post, N. Y., Dec. 20, 1886. Parents, Frank E. and Margaret (Hastings) Bronson. Education, ME, Cornell University, 1910. Married Elizabeth Wilson, 1911. Married 2nd, Elizabeth Dekeyser, 1942. Assoc-Mem. ASME, 1915; Mem. ASME, 1922. Mr. Bronson was associated with the Kewanee Boiler Division for 42 years. He served the Society on the Boiler Code Committee in 1917. Survived by his widow, Elizabeth Dekeyser Bronson, two sons, Carlos E., Jr., and George A. Bronson; and a daughter, Carla E. Bronson.

Chester W. Bros (1900–1958), executive vice-president and board member Bros, Incorporated, Minneapolis, Minn., died Jan. 14, 1958. Born, Minneapolis, Minn., Oct. 29, 1900. Parents, William and Magdalena Bros. Education, MS, University of Minnesota, 1924. Married Hazel Spears. Assoc-Mem. ASME, 1930; Mem. ASME, 1935. Survived by his widow and three children, Donn G., David E., and Garet Bros.

Clyde Ernest Brown (1905–1957), textile-machine design engineer, DeWalt Machine and Engineering Co. and Machine Design Associates, Worcester, Mass., died Aug., 1957. Born, Upton, Mass., March 18, 1905. Education, Wentworth Institute, 1925. Mem. ASME, 1946. Held 16 patents for textile machinery and tools.

William Francis Canavan (1873–1958), retired president, Leader Iron Works, Decatur, Ill., died Jan. 2, 1958. Born, Morris County, Kan., July 9, 1873. Education, high-school graduate; ICS. Mem. ASME, 1920. During World War I, Mr. Canavan served as a major with the U. S. Army Engineers. After the war he joined the Leader Iron Works and remained with them until his retirement.

Edgar Boyd Cole (1916–1957), senior engineer, Refinery Division, Bechtel Corp., San Francisco, Calif., died Sept. 29, 1957. Born, Lewiston, Utah, Sept. 14, 1916. Education, BS(ME), University of California, 1939. Mem. ASME, 1949. A specialist in sugar process and power-plant work, Mr. Cole was a registered engineer in the State of Utah. Survived by his widow Mrs. Edgar B. Cole, Nyssa, Ore.

Chauncey Hilton Durkee (1892–1958), formerly supervising editor, Hazeltine Electronics Corp., Little Neck, L. I., died Feb. 1, 1958. Born, Haverhill, Mass., Oct. 24, 1892. Parents, J. Walter and Emma E. Durkee. Education, BS(ME), Massachusetts Institute of Technology, 1915. Married Katherine W. Clendinning, 1920. ASME Managing Editor (died 1956). Jun. ASME, 1919; Assoc-Mem. ASME, 1935; Mem. ASME, 1935. During World War I, Mr. Durkee served as a first lieutenant in the U. S. Army Ordnance Engineering Division.

Augustus Hill Elliot (1884–1958), formerly with American Brake Shoe and Foundry Co., Philadelphia, Pa., died Feb. 3, 1958. Born, New Rochelle, N. Y., Feb. 7, 1884. Education, PhB(ME), Yale University, 1904. Assoc-Mem. ASME, 1914; Mem. ASME, 1935. Survived by two sisters, Nellie P. Elliot and Katherine Elliot Manson, New Haven, Conn.

Horace Hovey Esselstyn (1874–1958), consulting engineer, Detroit, Mich., died Jan. 8, 1958. Born, Detroit, Mich., Dec. 26, 1874. Parents, Justus Nash and Louise (Hovey) Esselstyn. Education, attended night courses at Columbia University and Cooper Union. Married Clara Gillespie, 1904 (died 1937). Mem. ASME, 1909; Fellow ASME, 1946. In 1916, he entered his own consulting practice providing design and supervision of the building of many large industrial plants, power plants, automobile plants, bridges, and so on. He was the engineer for the Belle Isle Bridge, Detroit, Mich., and subcontractor on the foundations of the Ambassador Bridge across the Detroit River. He served the Society as president of the Detroit Section and was active on the Michigan Membership Committee, the Papers Committee, and so on. He had been commissioner of many civil departments in Detroit including Public Works, Street Railways, and such. He had been city manager of San Diego, Calif. Survived by his second wife; a son, Willard A.; and five grandchildren, New Delhi, India.

Charles Owen Fairchild (1899–1957?) whose death recently was made known to the Society, had been a consultant, Fairfax, Va. Born, Marinette, Wis., Feb. 27, 1890. Parents, Asa Albert and May (Graves) Fairchild. Education, BS(CE), Rose Polytechnic Institute, 1912; MS, 1920. Married Edith Drescher, 1920. Mem. ASME, 1944. A specialist in temperature measurement and control, he was a licensed professional engineer in the State of New York. He held many patents in the field of instruments and temperature control theory, and was the author of at least thirty published papers on similar subjects.

John Thomas Ferris (1894–1958), consultant, Allentown, Pa., died 25, 1958. Born, Elizabeth, N. J., May 27, 1894. Parents, John Thomas and Frances Anne (Davis) Ferris. Education, high-school graduate; ICS; and Alexander Hamilton Institute. Married Edith H. Rhoades, 1915. Assoc-Mem. ASME, 1921; Mem. ASME, 1930.

David Gaehr (1876–1958), consultant, Cleveland, Ohio, died Jan. 7, 1958. Born, Strassburg (Alsace-Lorraine), Germany, May 9, 1876. Parents, Rev. Gottlieb and Jacobea (Zurbrugg) Gaehr. Education, attended gymnasiums in Switzerland, Germany, and France; ME, Cornell University, 1901; and ICS. Married Winifred Callahan, 1927. Assoc-Mem. ASME, 1902; Mem. ASME, 1909. For the major part of his career, Mr. Gaehr had been engaged in private consulting practice chiefly in the field of materials handling. For 31 years he also was an instructor in charge of the Lake Carriers' Association Engineers' School. Mr. Gaehr had served the Society in a great many capacities. He was a member of the Executive Committee of the Cleveland Section, 1932–1935, and was a member of its Nominating Committee. Survived by his widow.

Frank Xavier Gilg (1900–1958), executive assistant, The Babcock & Wilcox Co., New York, N. Y., died Jan. 26, 1958. Born, Elizabeth, N. J., June 6, 1900. Parents, Frank Xavier and Mary (Feth) Gilg. Education, BS(ME), Cooper Union, 1923; ME, 1926. Married Helen D. Tatnall, 1929 (deceased Jan. 26, 1958). Mem. ASME, 1941. Mr. Gilg had been with B&W since 1921. He served the Society as a member of the Boiler and Pressure Vessel Committee since 1954 and, in addition, served on the Subcommittee on Care of Steam Boilers in Service, Subcommittee

(*ASME News continued on page 154*)

ANNOUNCING THE

23rd National Exposition of Power & Mechanical Engineering

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on Power Boilers, and the Executive Committee, as well as many special committees and subgroups. He was chairman of the International Standards Organization Committee for the Unification of Boiler Codes. Mr. Gilg was the author of many technical papers on boilers, superheaters, and special furnace designs. Survived by two sons, Frank T. and D. Roger Gilg.

John Guy Glasgow (1884–1958?), whose death recently was made known to the Society, had been retired assistant manager, Gulf Refining Co., Pittsburgh, Pa. Born, Glasgow, Pa., July, 1884. Education, BS, Pennsylvania State College, 1909. Mem. ASME, 1918. Survived by a daughter, Mrs. G. R. Geeseman.

Francis Kalman Grulick (1893–1957?), whose death recently was made known to the Society, had been purchasing assistant, F. L. Smidth and Co., New York, N. Y. Born, Budapest, Hungary, Sept. 27, 1893. Education, BS(CE), Polytechnic Institute of Brooklyn, 1918; ME, 1924. Mem. ASME, 1950.

John Chapin Harvey (1884–1958), chief engineer, Boston Ordnance District, Army Base, Boston, Mass., died Jan. 23, 1958. Born, Chesterfield, N. H., July 4, 1884. Parents, Herman C. and Ella G. Harvey. Education, BS, Worcester Polytechnic Institute, 1908; ME, 1910. Married Mary Frost, 1910. Mem. ASME, 1952. Mr. Harvey had taught hydraulics, power transmission, and gas engineering periodically at Worcester Polytechnic Institute. Survived by his widow and four children.

Laurence Harold Headley (1897–1957), superintendent of mechanical construction, Philadelphia Electric Co., Philadelphia, Pa., died July 14, 1957. Born, Atlantic City, N. J., Jan. 29, 1897. Education, high-school graduate; ICS. Mem. ASME, 1948. Mr. Headley had been associated with Philadelphia Electric Co. since 1924. Survived by Mary E. Headley.

Max LeClair Hokanson (1915–1957), boiler room engineer, Commonwealth Edison Co., Chicago, Ill., died Dec. 2, 1957. Born, Lake City, S. D., April 2, 1915. Education, BS(ME), South Dakota State College, 1937. Mem. ASME, 1954. With the exception of six years spent in the U. S. Army Air Force during World War II, Mr. Hokanson had been with Commonwealth Edison since 1937. He was a registered engineer in the State of Illinois. Survived by his widow.

John E. Hubbell (1876–1957), partner in the firm of Hubbell and Cohen, New York, N. Y., died Dec. 14, 1957. Born, Altona, Ill., Oct. 11, 1876. Education, attended Northwestern University; BS(EE), Rose Polytechnic Institute, 1898; LLB, National University Law School, 1901; Master of Patent Law, Columbia University, 1902. Mem. ASME, 1923. Survived by his widow, Betty S. Hubbell; a daughter, Mrs. Marian Gawthrop; and a son, John W. Hubbell.

George Ernest Hunter (1859–?), whose death several years ago was recently made known to the Society, had been factory manager of the Elgin National Watch Co., Elgin, Ill., before his retirement. Born, Waltham, Mass., Nov. 29, 1859. Parents, George and Louise Jane (Conner) Hunter. Education, attended college preparatory school. Married Malvina Bell Taylor, 1885; three children, Donald Taylor, Marjorie Bell, and George Richard Hunter. Mr. Hunter had been with the Elgin National Watch Co. from 1877 to 1925 when he retired. Mem. ASME, 1890.

Eric Francis Hyde (1887–1957), president, Hyde and Bobbie, Inc., Detroit, Mich., died Aug. 22, 1957. Born, Detroit, Mich., April 12, 1887. Parents, Francis and Caroline S. (Knox) Hyde. Education, BS (ME), University of Michigan, 1913. Married Mary F. Tripp, 1915; one daughter, Jane C. Tripp. A registered mechanical engineer in the State of Michigan, Mr. Tripp had been a heating, ventilating, and plumbing specialist. Mem. ASME, 1956.

William Johnson Kihn (1891–1958), vice-president in charge of manufacturing and production, Thatcher Furnace Co., Plainfield, N. J., died Jan. 31, 1958. Born, Hamilton, Ohio, Sept. 22, 1891. Parents, Joseph and Rosa Kihn. Education, attended University of Cincinnati. Married Clara Woodruff, 1917; three children, William W., Patricia, and David Kihn. Assoc-Mem. ASME, 1920; Mem. ASME, 1935. Mr. Kihn had published several articles in the technical press.

John J. McBride (1872–1957), formerly in charge of steel car construction at American Car and Foundry Co., New York, N. Y., died Dec. 1, 1957. Born, Wilmington, Del., Dec. 21, 1872. Education, City College of New York. Married Kathryn Cosgrove. Assoc-Mem. ASME, 1917; Mem. ASME, 1935. During World War I he served the government in his field and received a presidential citation for his service. He served the Society as a member of several committees. He had been a licensed and registered engineer in the State of New York. Survived by his widow, Kathryn Cosgrove McBride; and two sons, John C., Alexandria, Va.; and Richard G., The Bronx, N. Y.

Malcolm McIntyre (1883–1957?), whose death recently was reported to the Society, had been vice-president, Bergen Point Iron Works, Bayonne, N. J. Born, Brooklyn, N. Y., March 16, 1883. Education, BS(ME), Columbia College, 1905. Mem. ASME, 1918. Mr. McIntyre held patents on automatic trolley controls.

James David Mooney (1884–1957), chairman of the board, Technical Managers, Inc., New York, N. Y., and formerly chairman of the board and president, Willys-Overland Motors, Inc., Toledo, Ohio, died Sept. 21, 1957. Born, Cleveland, Ohio, Feb. 18, 1884. Parents, James D. and Mary Elizabeth (Burns) Mooney. Education, BS, Case Institute of Technology, 1908; BS, New York University, 1927; ME, Case Institute of Technology, 1929; DE, 1935. Married Leonora Watson, 1914; children, Martha Jane, James David, Patricia Avice. Married 2nd, Ida May Mac Donald, 1929; children, Michael Mac Donald, John Burns, Alan Patrick. Mem. ASME, 1919. He served as a captain in the U. S. Army in France during World War I. As a captain in the United States Navy (Reserve) he saw active duty with the Bureau of Aeronautics, was in Europe with the Advanced Base Division, and on the Staff of the Chief of Naval Operations during World War II. Before assuming his position with Willys-Overland, he had been a director and vice-president in charge of overseas operations, General Motors Corp. from 1921 to 1942. Mr. Mooney had been a member of council of the New York University and had served for two years as general chairman, United Hospital Fund.

John Fred Mooney (1923–1957?), vice-president, Star Foundry and Machine Co., died recently. Born, New Lexington, Ohio, Sept. 24, 1923. Education, BS(ME), Ohio State University, 1948. Assoc. Mem. ASME, 1949.

Lawrence Kitchener Nelson (1906–1957), consulting engineer, New Orleans, La., died Dec. 8, 1957. Born, New Orleans, La., Feb. 12, 1906. Education, BE, Tulane University, 1927. Mem. ASME, 1944. Survived by his widow, Gladys F. Nelson.

Kenneth W. Pike (1898–1957), engineering and planning director, Engineering Division, The Quaker Oats Co., Chicago, Ill., died May 29, 1957. Born, Akron, Ohio, Aug. 7, 1898. Parents, O. C. and S. M. Pike. Education, ME, University of Akron, 1923. Jun. ASME, 1924, Assoc-Mem. ASME, 1926; Mem. ASME, 1935. Mr. Pike had been with Quaker Oats since 1923. He had been a member of the Akron Chamber of Commerce. He had taught engineering drawing at the University of Akron.

Edward Francis Roberts (1875–1957), retired vice-president of manufacturing, Packard Motor Car Co., Detroit, Mich., died Sept. 25, 1957. Born, Champlain, N. Y., Aug. 24, 1875. Mr. Roberts had been with Packard from 1903 until his retirement in 1935. Mem. ASME, 1946.

Montague Henry Roberts (1883–1957), vice-president, John Zelle Co., Bridgeport, Conn., died Sept. 20, 1957. Born, Pittsburgh, Pa., March 18, 1883. Parents, John W. and Kate (Smith) Roberts. Education, BS(ME), University of the State of New York. Married Cecilia White, 1912 (died Aug. 22, 1957). Assoc-Mem. ASME, 1912. Mem. ASME, 1917. In 1908, Mr. Roberts was one of a team which drove across the United States in a Thomas Flyer—a touring car—on the first lap of an around-the-world automobile race. Survived by his four children, Mrs. Lester J. Hayes, Dr. M. A. Roberts, Mrs. Jean Campbell, and Miss Selby C. Roberts.

Harold Valentine St. Clair (1909–1958), director of engineering, Jamiesonn Division, Arrow-Mill Lumber Corp., Los Angeles, Calif., died Jan. 24, 1958. Born, Durham, England, July 9, 1909. Education, BS, College of Engineering, Liverpool, England, 1930; attended Dobe Institute. Mem. ASME, 1947. Mr. St. Clair served with the Royal Canadian Engineers from 1939 to 1945. He had been active in community affairs and was an executive of the Council for Guidance of the Handicapped and a member of the Community Planning Association of Canada. Survived by his widow, Flora M. St. Clair, St. Gabriel, Calif.

Alfred Edgar Savina (1930–1957), designer, Pratt and Whitney Division, United Aircraft Corp., Manchester, Conn., died Aug. 12, 1957. Born, Meriden, Conn., April 6, 1930. Parents, Walter and Frances (Zorownti) Savina. Education, BS(ME), University of Connecticut, 1952. Married Florence Broadbent, 1954. Assoc. Mem. ASME, 1952. Survived by his widow.

Herbert Louis Schultz (1898–1958?), whose death recently was reported to the Society, had been superintendent of maintenance, Carborundum Co., Niagara Falls, N. Y. Born, Buffalo, N. Y., April 23, 1898. Parents Jacob and Louise Schultz. Education, ME, University of Pennsylvania, 1921. Married, 1923; four children, Herbert, Jr., Jane, Joan, and Daniel. Assoc-Mem. ASME, 1925; Mem. ASME, 1930. A specialist in factory equipment and maintenance, Mr. Schultz had published articles and papers on the subjects in the technical press.

Elmer Mansfield Schumo (1883–1957?), whose death recently was made known to the Society, had been president and general manager, Pennsylvania Electric Steel Casting Co., Hamburg, Pa. Born, Philadelphia, Pa., Nov. 20, 1883. Education, Temple University, 1904. Mr. Schumo was succeeded by his son, Robert M. Schumo, as president and general manager of the above firm.

Harold James Schutt (1929–1957), test engineer, Atomic Power Division, Westinghouse Electric Corp., Idaho Falls, Idaho, died Sept. 3, 1957. Born, Pocatello, Idaho, March 15, 1929. Parents, Harold Clifton and Ruth Helen (Howell) Schutt. Education, BS(ME), University of Idaho, 1952. Assoc. Mem. ASME, 1952. Married Margit Delight Paulsen, 1950; two childre Janice Lynn and Norma Lee.

Richard Johns Semon (1928–1956), area supervisor, U. S. Metals Refining Co., Carteret, N. J., died in 1956. Born, Brooklyn, N. Y., July 21, 1928. Education, BS(ME), Rensselaer Polytechnic Institute, 1952. Assoc. Mem. ASME, 1952. Survived by his widow.

Elhardt M. Siegel (1916–1957?) whose death recently was made known to the Society, had been manager, industrial engineering dept., Eastern Products Corp., Baltimore, Md. Born, Pittsburgh, Pa., Jan. 29, 1916. Education, attended The Johns Hopkins University. Mem. ASME, 1955. Mr. Siegel held a copyright on a special slide rule for use in the strip and sheet steel and the tin-plate industries. He held a patent for a furnace assembly and preheater, and was instrumental in the development of several others.

Leland Kenneth Spink (1899–1957), engineer in charge of flow measurement, The Foxboro Co., Foxboro, Mass., died Dec. 24, 1957. Born, Grand Island, Neb., Nov. 22, 1899. Education, attended the University of Kansas. Mem. ASME, 1942. Mr. Spink had published numerous articles on his specialty, differential type flow meters, in the technical press. He held several patents. For 31 years he had been an active member of ASME Research Committee on Fluid Meters during which time his contributions both in leadership and technical work have been outstanding.

Lawrence Cullman Stix (1886–1957), president, S. Oppenheimer and Co., Inc., New York, N. Y., died Nov. 7, 1957. Born, New York, N. Y., Sept. 16, 1886. Parents, Robert L. and Lena (Cullman) Stix. Education, ME, Columbia University, 1908. Married Babette Oppenheimer, 1913; two children, Lawrence Cullman, Jr., and Edgar Robert Stix, II. Assoc-Mem. ASME, 1911.

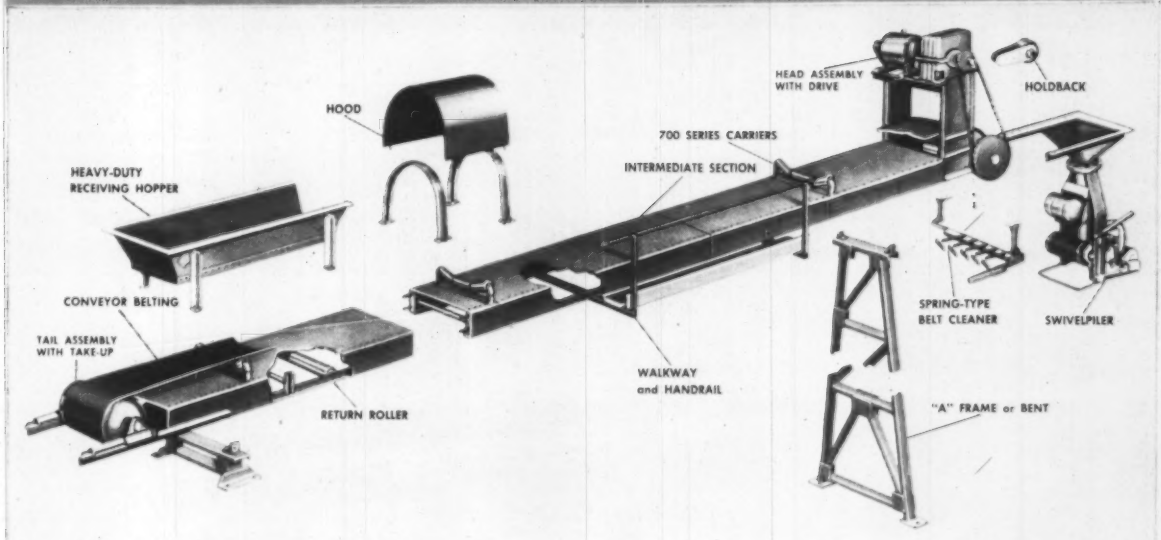
Charles E. Sweet (1870–?), president, Superior Machinery and Engineering Co., Detroit, Mich., died several years ago according to reports recently received by the Society. Born, Rockland, Mich., Aug. 23, 1870. Education, high-school graduate. Mem. ASME, 1907.

F. F. Uehling (1883–1958), consulting engineer, inventor, and retired industrialist, New York, N. Y., died Jan. 22, 1958. Born, Sharpsville, Pa., April 28, 1883. Parents, Dr. Edward A. and Jeanette (Mertz) Uehling. Education, Stevens Institute of Technology and study in England and Germany. Married Marie Fielding Dashiell, 1910. Mem. ASME, 1918. A specialist in combustion problems and the manufacture of hydrostatic instruments and combustion recorders, he held numerous patents. Among the instruments patented were pyrometers, thermometers, speed recorders, millivoltmeters, conductivity meters, and such. A more recent development was the cowl flap control for automatically maintaining cylinder head temperatures in aircraft engines. Mr. Uehling, in 1913, developed the chemical natron, a dry absorbent used extensively in oxygen tents, deep-sea diving equipment, underwater welding, and gas masks. The Chemical Warfare Service used an ammonia recorder which he developed during World War I. In this period also he served the War Service Committee in Washington as a fluid instrumentation specialist. Mr. Uehling had been president of the Uehling Instrument Co., Paterson, N. J., from 1915 to 1954, when he retired. He also served from 1935 until 1952 as consultant to the Briston Co., Waterbury, Conn. Survived by his widow; a daughter, Miss Katherine Fielding Dashiell Uehling; and a brother, Edward Uehling, West Allis, Wis.

Francis Smith Williams (1902–1957), engineer, Rogers Machine Works, Inc., Alfred, N. Y., died June, 1957. Born, Alfred, N. Y., March 14, 1902. Education, BS, Alfred University, 1925. Mem. ASME, 1943. Mr. Williams had been a specialist in the design of vertical boring mills and held a patent for a related mechanism.

Richard Martin Yousoufian (1915–1957), consulting engineer, Bedford, N. H., died Sept. 4, 1957. Born, Constantinople, Turkey, Aug. 23, 1915. Education, Lowell Institute School, 1937. Mem. ASME, 1949. A specialist in the over-all supervision of engineering of steam-generating plants. Mr. Yousoufian had been a registered engineer in the State of New Hampshire.

NOW STEPHENS-ADAMSON COMBINES ITS QUALITY CONVEYOR COMPONENTS INTO A Pre-Engineered SECTIONAL BELT CONVEYOR



ALL NEW . . . NO OTHER COMPETITIVELY PRICED PACKAGED CONVEYOR LIKE IT! EXCLUSIVE ENGINEERING FEATURES ASSURE POSITIVE SATISFACTION

Here in one competitively priced, complete packaged unit is the efficient, economical and dependable answer to your conveying needs. The combination of STEPHENS-ADAMSON exclusive bent-plate decking, new pulleys with revolutionary crown, and quality conveyor components assure easy erection, maximum flexibility and minimum maintenance cost. Four high-strength bolts fasten head assembly . . . four bolts join intermediate sections . . . six bolts connect tail assembly offering simplified conveyor erection and alteration. More for your purchasing dollar today . . . more for your conveying dollar tomorrow!

Bent-Plate Decking—Punched every eight inches in rows on top, bottom and along its sides; the sturdy, 12 foot sections of steel decking provide many advantages over conventional truss-type construction. In addition to simplified erection and ease of alteration of conveyor, the decking provides protection for return belt run. Return rollers are mounted on underside, shielded from falling material.

- **STEPHENS - ADAMSON Pulleys** — Revolutionary new crown providing more belt training effect with less belt stress . . . featuring new all-steel S-A "Squeezelock" Hub.
- **STEPHENS-ADAMSON 700 Series Carriers** — Precision ball bearing carrier rollers (4" or 5") assure smooth, trouble-free performance. Roller bearing carriers optional.
- **SEALMASTER Self-Aligning Ball Bearing Units** — Performance proven in countless conveyor installations.
- **SACO Speed Reducer** — Rugged, compact, quiet unit... famous for dependability.
- **STEPHENS-ADAMSON Spring-Type Belt Cleaner**—Wipes belt clean of wet or dry materials. Simple to install, adjustable, saves belt, eliminates clean-up maintenance.
- **STEPHENS-ADAMSON Holdback** — Easily mounted on headshaft to prevent belt reversal. Protects equipment and personnel.
- **STEPHENS-ADAMSON Swivelpiler** — Extends reach of conveyors tenfold through centrifugal thrower principle.
- AVAILABLE IN 18", 20", 24", 30" and 36" width conveyors . . . Delivered from stock!

STANDARD PRODUCTS DIVISION
STEPHENS-ADAMSON MFG. CO.

WRITE FOR BULLETIN 458

GENERAL OFFICE & MAIN PLANT:
19 RIDGEWAY AVE. — AURORA, ILL.

PLANTS AT: CLARKSDALE, MISSISSIPPI • LOS ANGELES, CALIFORNIA • BELLEVILLE, ONTARIO

Owner: FIELD ENTERPRISES, INC.
Architects-Engineers: NAESS AND MURPHY
General Contractor: GEORGE A. FULLER COMPANY
Plumbing Contractors: G. F. CONNELLY CO.
Heating Contractors: KROESCHELL ENGINEERING CO.
Air Conditioning Contractors: WILLIAM A. POPE COMPANY

NEW CHICAGO SUN-TIMES BUILDING

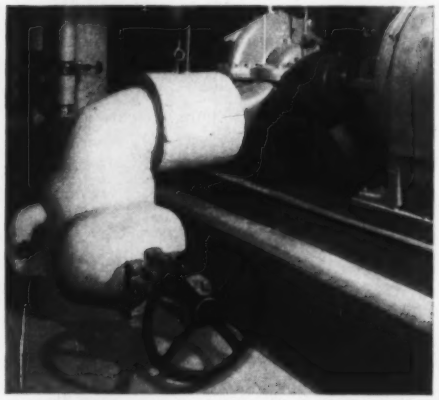
equipped with long-lasting, dependable JENKINS VALVES

IN ADVANCED PLANNING, as in location and design, the new Sun-Times Building is front-page news. For this is the first project to be completed in a development which will transform the area north of Chicago's Loop into a city of the future.

There can be only one basis for selecting physical equipment for such a plant: the ability to perform efficiently and economically *for years*. This is why Jenkins Valves are standard on all plumbing, heating and air conditioning lines in the block-long structure.

The extra measure of performance and reliability built into Jenkins Valves has for generations assured long operating life and low maintenance cost. That's well to remember when you specify valves . . . especially since the valves that bear the famous Jenkins Diamond mark *cost no more.* Jenkins Bros., 100 Park Avenue, New York 17.

Sold Through Leading Distributors Everywhere



10" Fig. 651-A Jenkins Iron Body Gate Valve, fitted with by-pass, on suction line of pump which supplies Chicago River Water as condenser water and process water for type foundry requirements.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864
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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

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NEW EQUIPMENT

Mechanical Roll Neck Seal

Syntron Company announces a mechanical roll neck seal for bearings on work and back-up rolls in strip mills, tempering mills and other rolling mills.

The seal is self-contained and consists of two maintenance-free components which provide positive, two-way sealing to keep water out and lubricant in, the company reports.

A flexible, specially compounded, long-wearing rubber element fastens to and revolves with the roll neck. This element seals against the burnished walls of its housing which is stationary in the roll neck bearings. —K–1

Miniature Adjustable Stop

Precision Mechanisms Corp. announces a miniature multiturn adjustable limit stop for the servo, instrument, and precision mechanism industries.

The new stop is available in two models, 0–10 revolutions and 0–40 revolutions. It features a single range-setting screw, available at the end cap, which is capable of adjusting stop rotation from zero to full scale continuously and with precision.

The limit stop is 0.875 in. diam, synchro mounted, $1^{5}/_{32}$ in. long in the 0–10 turn model and $1^{7}/_{8}$ in. long in the 0–40 turn model. Shaft diameter is 0.125 in. Other major features are its torque capacity of 40 oz in., precision ball bearings, and construction of corrosion resistant steel and anodized aluminum which conforms with the applicable sections of MIL-E-5400. —K–2

Glass-Coated Smokestack

Ninety-five per cent of all unlined carbon steel smokestack failures are caused by inside-the-stack corrosion with only five per cent of failures the result of outside atmospheric conditions, a report by A. O. Smith Corp. reveals.

The special report prefaces an analysis on the firm's new development, the Permaglas smokestack. The smokestack—built to provide 300 to 500 per cent longer protection against corrosion—uses the firm's specialized glasses to achieve a superiority in resistance regardless of excess condensate or intermittent operation, the company reports. —K–3

Load Socket

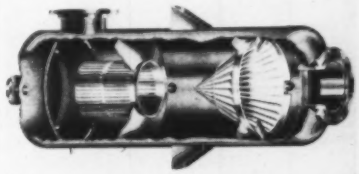
A double wedge load socket, designed to provide a quick and easy method of removing the load cable from the socket, is announced by Pace Engrg. Co.

According to the firm, one man, equipped with a hammer or small sledge, can easily release the cable in a few minutes' time.

The new design employs two wedges instead of the single wedge type. The bottom and smaller wedge is not removable, but slides forward and back on a pin and slot arrangement. The top wedge is removable and is large enough so that the cable can be wrapped around without difficulty. With the cable in place and pull applied, the two wedges slide forward and securely hold the cable in place.

To release, it is only necessary to give either wedge a sharp tap with a hammer. This slides the bottom wedge back in its slot, releasing the pressure, and the top wedge can then be lifted out and the cable removed.

The load sockets are available in manganese or heat treated alloy steel and are heavily reinforced on the bottom and other points. The grooves of the wedges are shaped so that the cable cannot be flattened or distorted, the company reports. The sockets are available in sizes to accommodate wire cable from $1^{5}/_{8}$ through $3^{1}/_{8}$ in., with single, double or triple eye connections. —K–4



Vapor Scrubber

A low-cost, easy to install means of removing solid or liquid entrainment in gas or vapor is claimed to be available with the WD scrubber, being announced by Centrifix Corp.

The unit is guaranteed to remove 99.5 per cent or more of such entrainment regardless of size (1 micron or smaller), density or chemical characteristics. The firm says the scrubber can be designed for any operating pressure, flow rate or temperature.

The unit combines the firm's patented washing tuyere with its patented helicoid drying tuyere. This is designed to provide removal of such contaminants as fly ash from boilers or incinerators, oil mists incident to food processing, acid fumes from chlorine production, vaporized oil encountered in compression of air and gases, sulfides from natural and refinery gases. The process is also said to be suitable for humidifying gases for evaporative cooling of water.

The unit has no moving parts, and is said to be self cleaning and non-clogging. The company says the purifying job is done entirely by centrifugal action upon the moving gas or vapor with a minimum pressure drop. —K–5

Side Shift Attachments

A side shift attachment for its Clarklift line of fork trucks has been introduced by the Industrial Truck Div., Clark Equipment Co.

The attachment is said to permit truck operators to shift loads right or left for precise spotting. It gives accurate control of warehouse tiering or carloading without requiring the fork truck to be maneuvered into exact position, the company states.

The attachment is available in two models. The standard side shift gives 3 in. shift to either side, and is designed for the firm's 2000 lb capacity fork truck.

A heavy-duty side shift attachment, intended mainly for movement of brick, concrete block, and heavy building materials, is interchangeable among 3000 to 5000 lb capacity trucks. It provides 4 in. shift. —K–6

Steel Mill & Industrial Machinery

Construction Equipment

Bridges

Paper, Food, Rubber & Textile Machinery

Baking Ovens & High Temp. Equipment

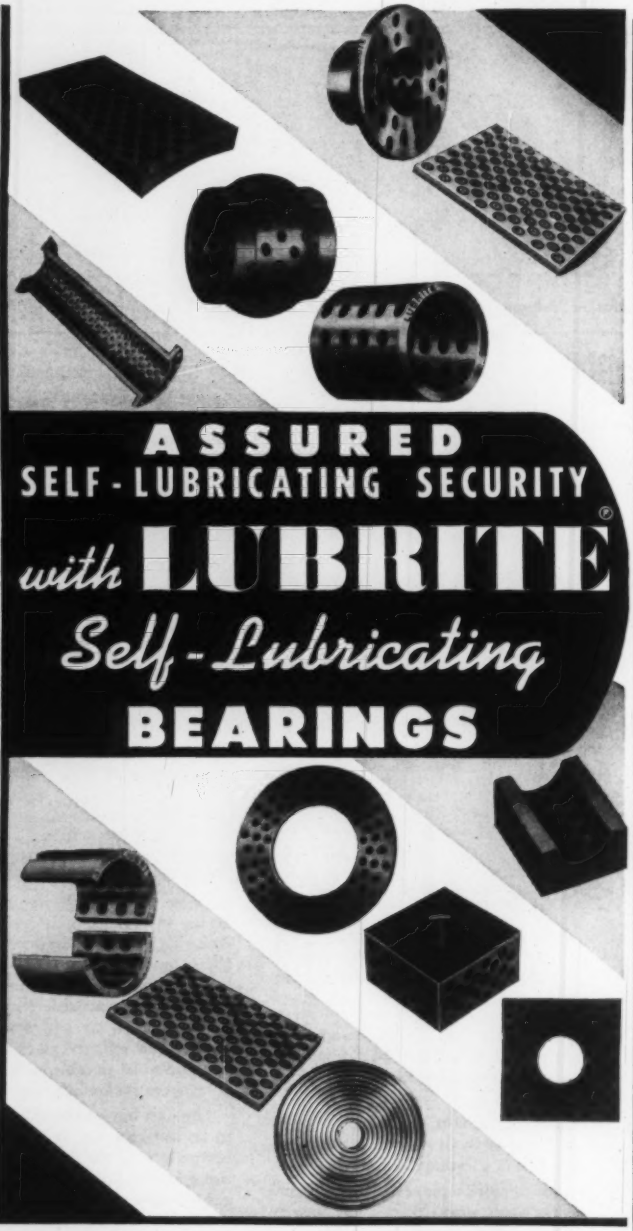
Chemical & Refinery Processing Plants

Overpasses & Structures

Wind Tunnels

Hydro-Electric Gate Bearings and Accessory Equipment

Materials Handling Equipment & Conveyor Systems



Lubrite self-lubricating bearings offer great versatility in hundreds of fields where dependability and superior performance are of prime importance.

Lubrite Bearings, with clean, permanent, maintenance-free self-lubrication are designed to withstand severe loadings, temperature extremes, submersion, corrosion and other adverse conditions.

Lubrite may be just the bearing you need in your designs to obtain better results.

Consult our Engineering Department on your application. No obligation.

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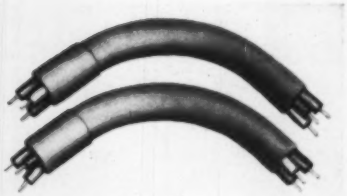


PVC Conduit

Kraloy Plastic Pipe Co. announces a new PVC rigid polyvinyl chloride electrical conduit, engineered with inside diameters to Underwriter's conduit specifications, and available for use in all power and communications wire installations.

The company says the cost of installation is of the conduit lessened by one half. Because of its semirigid characteristics, Kraloy plastic conduit can easily be worked into contours. The electrician needs only a hack-saw and the cement necessary to chemically weld sections together.

Because of its plastic properties, Kraloy conduit does not rust or corrode. It will not support combustion and other disturbances; is waterproof with an indefinite life span, the company claims. —K–7

Multi-Speed Transmissions

Turner Uni-Drive, 3403 Terrace St., Kansas City 8, Mo., announces Models 240 and 540 transmissions, with selective gears in 4, 6, and 9 ranges of speed.

According to the company, standard high to low output ratios vary from 4.7/1 to 8/1, with maximum 12.4/1 step-down; a step-up ratio of 1/8 is possible in certain applications. Dimensions are 17 × 19 × 7 in. for Model 240, and $20\frac{1}{2} \times 20 \times 7\frac{1}{2}$ in. for Model 540 gearboxes.

The units have close-grained grey iron housing, 20-deg stub tooth gears, and tapered roller bearings tested for overhung loads. They are designed for application on road machinery, oil or water pumping rigs, conveyors, testing machines, textile frames, rolling mills, wire drawing spindles, oil core-drills, and paper-making rolls.

Standard units are designed in from 1 to 60 hp capacities, with special transmissions available upon request. —K–8

Nuclear Core Control

Vard, Inc. announces that it has completed the initial production contract for nuclear core control mechanisms for the Westinghouse atomic reactor program.

The firm says that more than 90 per cent of the entire nuclear control mechanisms were manufactured by Vard within the confines of its Pasadena plant operations. Assembly and test is performed under surgically clean conditions in a specially designed facility, the company states. —K–9

KEEP INFORMED

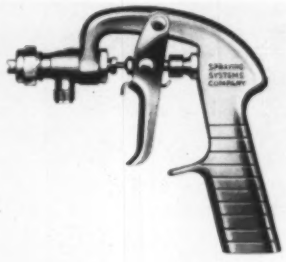
BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Caliper Square

American and Overseas Trading Co. announces introduction of a new caliper, called Polyplan caliper square, manufactured in Switzerland.

According to the company, the unit measures distances between points situated on two different axies as easily as distances between points situated on one axis. It makes it possible to take measurements of a part that is being machined, without removing the part from the machine, the firm states. These features have been achieved by a hinged lower jaw, which rotates 180 deg in a plane parallel to the measuring surfaces of the jaws.

Vernier lower scale permits readings to $^1/_{1000}$ in., upper scale has fractional division in inches. Size 9 in. is being manufactured at present, and smaller calipers will follow, the company says. —K-10



Chemical Spray Gun

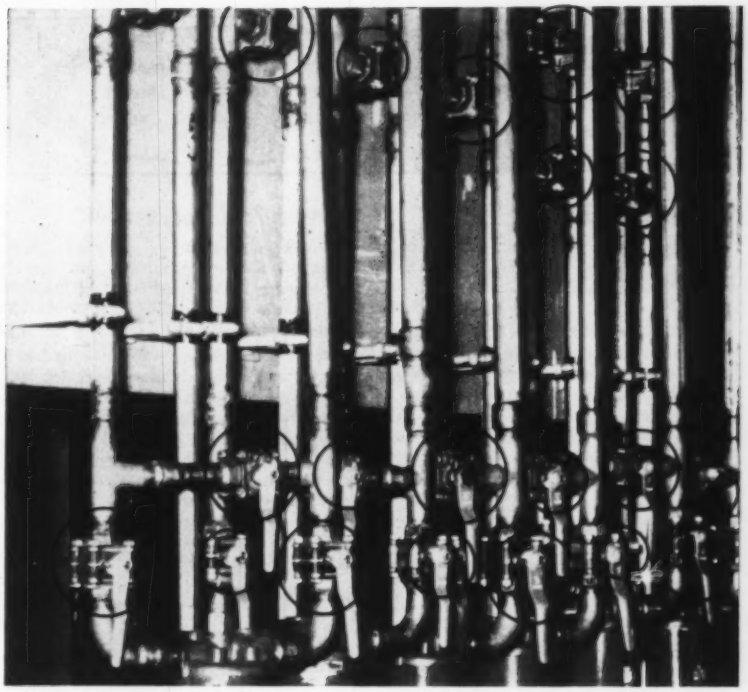
Spraying Systems Co. announces a new Gunjet, No. 22, which has a few parts that actually come in contact with the chemical sprayed.

As a result, use of costly chemical resistant materials can be restricted to these few parts, and an overall high quality gun can be offered at relatively low cost, the company reports.

The gun is supplied in choice of body, cap and tip made of brass with combination brass, stainless and nylon internal valve parts and body, cap and tip made of stainless steel with combination stainless and nylon valve parts. Handle of the gun is a heavy duty aluminum casting and the trigger is of thick-section plated steel.

Spray control is positive and instantaneous with immediate drip-free shut off, the firm says. The gun is designed for pressures up to 800 psi.

A wide range of interchangeable orifice tips in brass and stainless steel are available. Tip types include flat spray, Cone jet spray, full cone, disc type and solid stream. Each type is offered in a choice of capacities. Tips are easily changed from one capacity and type to another merely by removing the cap, it is reported. —K-11

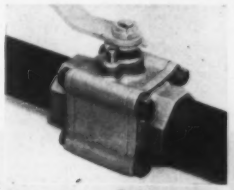


Only the ECON-O-"MISER" Ball Valve was able to solve this problem for PathéColor, Inc.

THE PROBLEM: To find a valve that would meet all of the following requirements:

1. Quick visual indication of position and quarter turn operation. 2. Excellent flow characteristics and positive shut-off. 3. The advantages of flange construction without the bulk and weight of conventional flanged valves. 4. Easy & quick disassembling for low cost maintenance. 5. The most compact and economical installation of Type 316 stainless steel valves possible.

SOLUTION: *Specifying* and *installing* Worcester's Econ-o-"miser" Ball Valve. In so doing PathéColor found a valve that provides a positive seal, a flanged construction much more compact than conventional valves that could be socket welded. In addition many unions and companion flanges were eliminated with the overall result that savings on this installation alone amounted to many hundreds of dollars.



Valves available, ¼"-2", in following standard materials*: Bronze, Aluminum Bronze, Aluminum, Carbon Steel and Types 303 and 316 Stainless Steel. Standard Seat and O-Ring materials*: Buna-N, Neoprene, and Teflon.

**Other materials available on request.*

For further information and descriptive literature write to:

WORCESTER VALVE CO., INC.

16 PARKER STREET • WORCESTER, MASS.

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Stock Chain Drives

A major increase in the number of types and sizes in its line of standardized stock sprockets and chain has been announced by Boston Gear Wks.

Steel and iron sprockets for 1½, 1¾, and 2 in. pitch chain have been added in the heavier duty size range. These include plate, single hub, and double hub types.

The company reports that now available in the lighter duty range are steel plate sprockets (Type A) and sprockets with hub (Type B) for ½ to 1¼ in. pitch chain.

Additions also include double pitch roller chain in the three commonly used types. The drive series and agricultural series are available in 1, 1¼, and 1½ in. pitch, and the conveyor series in this range plus 2 in. pitch. —K–12

Lift Truck Carton Clamp

Moto-Truc Co. has introduced a new carbon clamp with side shifting device for use on its line of walkie and Ride-A-Man counterbalanced fork trucks.

Designed for handling appliance cartons and other stable shipping containers, the new clamp is said to be suited for freight car and street truck loading. Because the specially designed clamp arms are extremely short and thin, they facilitate close order stacking and easy maneuvering in confined areas, the company reports.

The clamp is operated by a pair of double-acting hydraulic cylinders, power for which is supplied by the same pump and motor used to power the lift and tilt mechanism. The same cylinders which operate the clamp arms also serve to operate the side-shifter. The firm says a unique piping arrangement permits lateral shifting of the load with the clamp in the closed position. The hydraulic circuit includes an automatic pressure relief valve to prevent excessive clamping pressure and a check valve to maintain clamping pressure in the event of hydraulic line failure. Operating controls for the clamp and side-shifter are located for the convenience of the operator. —K–13

Irregular Area Measurement

A new method said to perform the same basic functions as a planimeter, considerably faster and at less cost, has been introduced by the Charles Bruning Co., Inc., under the trade name Areagraph.

It is described as an inexpensive method of quickly and accurately measuring irregularly shaped areas on maps, drawings, charts, photographs, and plane objects. Areas are measured by placing an overlay (a transparent film printed with a pattern of grids and dots) over the area to be measured. The dots falling within the area to be measured are counted and then divided by a simple factor printed on the overlay. The answer is given in square inches. —K–14

Oil-Free Rotary Pump

Miehle-Dexter announces a rotary, oil-free pump equipped with shaft seals for gas-tight operation at pressures up to 10 psi.

The firm says the unit, called Dexter-Conde Dri-Air pump, has graphite vanes and lifetime bearings and requires no lubrication in service. Shaft seals also require no lubrication and hence pump components cannot contaminate the air or gas stream, the company reports.

The new shaft seals make the pump adaptable for handling gases which might be harmful to personnel or equipment should they leak into surrounding areas, it is stated.

The seals encircle the shaft and are located between the bearings and the rotor where they are protected from atmospheric dust and at the same time prevent corrosive gases from reaching bearing lubricants. One section of the seal rotates with the shaft while a second section remains stationary, being press fit into the pump end plate.

Faces of the two sections are designed to fit against one another, providing the gas-tight seal. Mating surfaces are lapped optically flat and the stationary surface is spring loaded to provide perfect contact and leak-proof operation. —K–15

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Supervisor, Engineering Personnel
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Dallas, Texas

I am a _____ Engineer,
interested in the opening for _____
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Vought Vocabulary

re·lent′less: *a missile that pierces hostile sky to pinpoint its nuclear strike*

When a target's latitude and longitude are marked on this missile's brain, an appointment has been made.

To keep its rendezvous, the Chance Vought *Regulus II* performs miracles of navigation: it will launch stealthily from submarines – nuclear and conventional – from surface craft and mobile shore launchers. It will compensate automatically for wind and weather and for the earth's rotation. It will detour enemy strongpoints, outfox known counterweapons. Closing in on its quarry, it can plummet from over 60,000 feet to smokestack height to escape radar detection.

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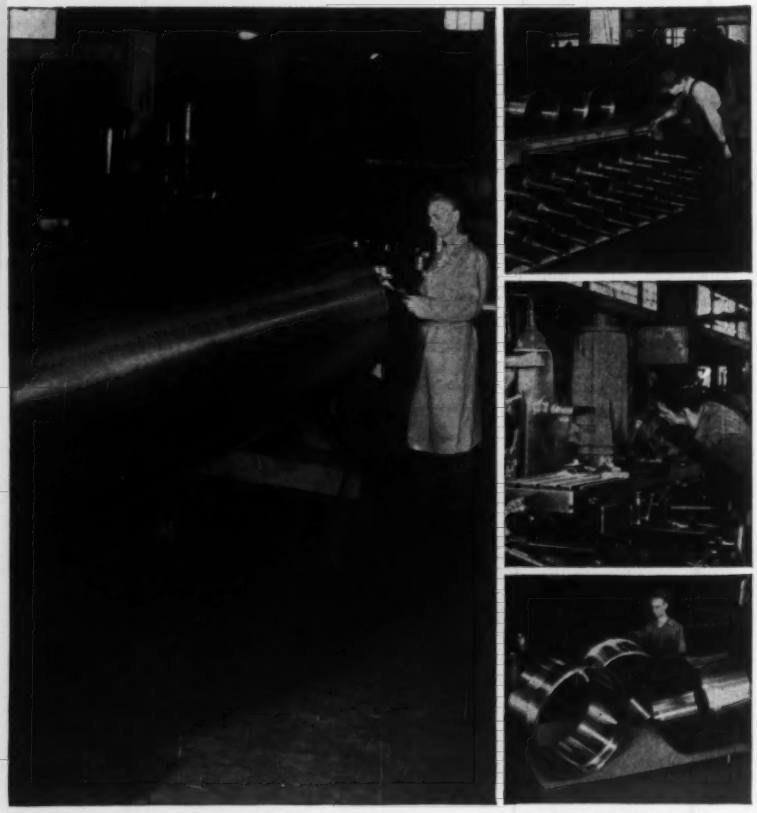

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Plug-in Steam Units

A series of portable plug-in electric steam generating units, designed for small steam applications, is announced by Electro-Steam Generator Corp.

The units produce steam at low pressures (0–15 lb) and high pressure (100 lb), and range in size from $^1/_2$ to 5 hp.

The company claims push button safety for the completely automatic units. They are said to be ideal for use where heavily saturated wet steam has caused difficulties and for air conditioned facilities and crowded areas. **—K–16**

Power Regulators

Redesign of its single-phase power regulators has been announced by Allis-Chalmers.

The regulators feature unit-type construction. Both transformer and tap-changing mechanisms of the redesigned unit are suspended from the cover to permit continuous leads to pass directly from the transformer coils to the double-bolt terminals on the dial switch.

The firm reports that this construction requires fewer bolted connections and makes it possible to remove or place the mechanism and transformers in the tank as a unit without disconnecting leads or removing terminals.

A new feature is a hinged cover on the side of the unit for inspection of the tap-changing mechanism. **—K–17**

Bituminous Paver

Iowa Mfg. Co., announces its Cedarapids bituminous paver which features a control system built around the use of electric brakes and clutches.

According to the company, the electric clutches and brakes permit a clean, uncluttered design for the drive and make control of the paver a finger-tip operation. The machine has been field-tested working at paving speeds of 65, 84, and 102 fpm, it is reported.

Power transmission for the paver starts from a 64.5-hp gasoline or a 61.1-hp diesel engine through a main clutch. An 18-speed transmission drives both the crawlers and the conveyor spreading mechanism. Six chains and two V-belts are used, whereas other similar systems may use as many as 17 chains and 10 V-belts, it is stated. Two sets of electric clutches are provided on the main drive to control the slat-feed conveyors and spreading screws for each side of the unit, and operate the crawler drive.

Conveyors and screws are powered through the 18-speed transmission by chain drives that operate each assembly at speeds synchronized with the crawlers. The control voltage is provided by a 6- or 12-v generator driven by the main engine. **—K–18**

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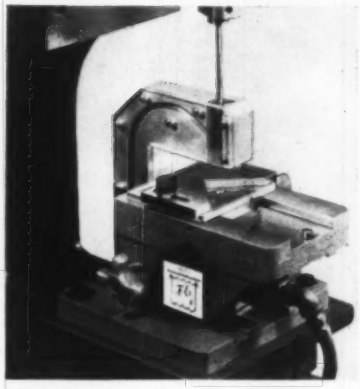

Ballizing Fixture

A Ball-O-Matic universal work-holding fixture is announced by Industrial Tectonics, Inc. for use in sizing and finishing holes by the ballizing process.

This process consists of pressing a ball of suitable size and hardness through the unfinished hole, and, the firm reports, provides high precision, fine finish, and cost savings up to 85 per cent or more.

The fixture accommodates a range of parts for ballizing holes of $^1/_{16}$ to $^1/_2$ in. diameter. It can be used on an arbor press, drill press, vertical broach, or other equipment having a vertical ram that will hold a push rod. The work is held in (or on) an anvil, which can be pulled forward for loading and pushed back against a positive stop to position the work for ballizing, the company explains.

After a hole is ballized, the ball is returned to the top of the fixture by air jet, along an internal track. The track is visible through a plastic side-piece, and the ball is readily removed for inspection or replacement. By tying in the air jet valve with the ram control, ball return is made automatic. When the ram moves down to ballize the next piece, the ball is automatically dropped into the hole ahead of the descending push rod.

The ball-release mechanism is contained in a vertical block, which also guides and supports the push rod. Interchangeable blocks are available for push rods of various diameters, and are adjustable vertically to give minimum clearance between the block and the top of the work. This prevents the ball from escaping and provides good support for the push rod. Preliminary vertical adjustment is obtained by means of interchangeable spacer blocks beneath the anvil.

The V-shaped anvil shown takes parts up to 3 in. OD and $1^5/_8$ in. height. It can be replaced by an anvil blank that can be drilled or countersunk to suit specific parts, or an anvil with a lever-operated jaw that prevents distortion of slotted holes during ballizing. —K-19

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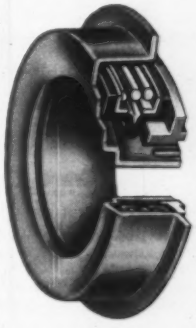
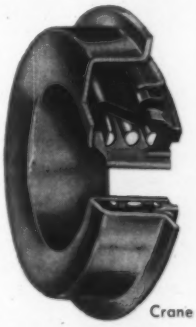


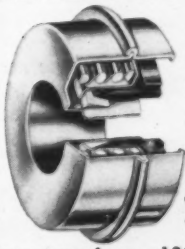
TYPE 6-A

Pressed-in packaged unit recommended for small shafts on hot or cold water, oil, gasoline or soapy liquids . . . pressures to 75 psi . . . temperatures from —65° F. to +220° F. Available in stainless steel or bronze.



TYPE 11-A

Pressed-in packaged unit with spring inside synthetic rubber bellows to protect against corrosion. For hot or cold water, oil, gasoline or soapy liquids . . . pressures to 35 psi . . . temperatures from —65° F. to +212° F.



TYPE 9-A

Packaged unit with wedge sealing ring made of DuPont Teflon. Will handle practically all known industrial chemicals and corrosives . . . pressures to 150 psi . . . temperatures from —120°F. to +500° F. Supplied in metallurgical specification best suited to the service.

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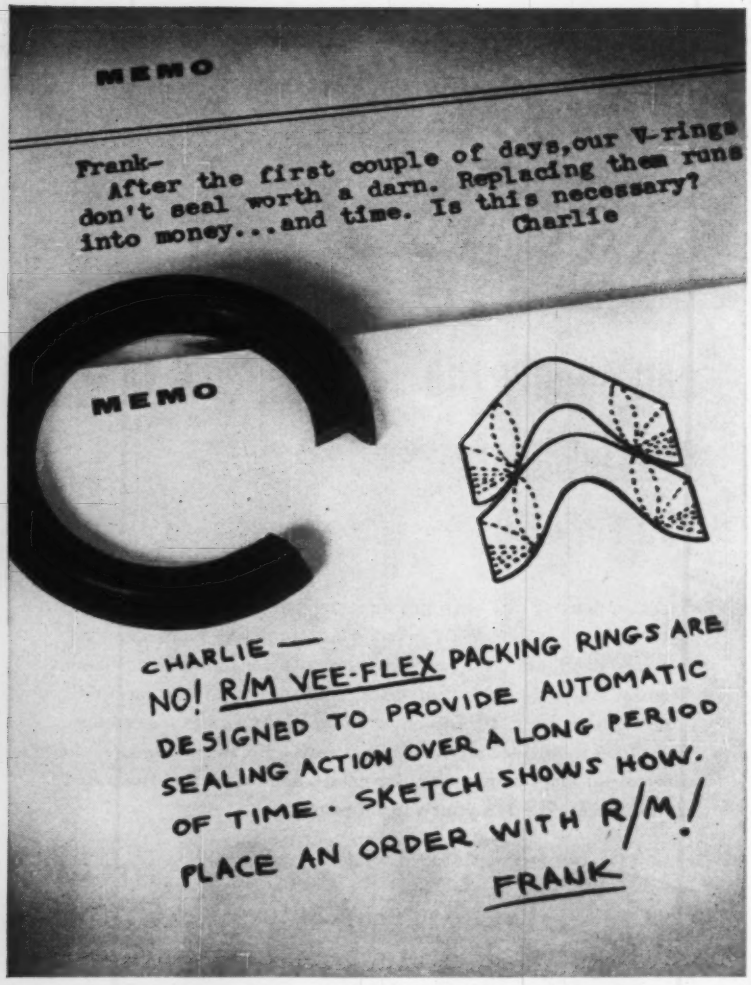
JOHN CRANE CRANE PACKING COMPANY


MEMO
Frank—
After the first couple of days, our V-rings don't seal worth a darn. Replacing them runs into money...and time. Is this necessary?
Charlie
MEMO
CHARLIE —
NO! R/M VEE-FLEX PACKING RINGS ARE DESIGNED TO PROVIDE AUTOMATIC SEALING ACTION OVER A LONG PERIOD OF TIME. SKETCH SHOWS HOW.
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Ordinary V-rings, with their flat surfaces, provide little or no automatic sealing action against the walls of the cylinder, with the result they quickly lose effectiveness. This means, of course, loss of power and eventually a maintenance problem. R/M Vee-Flex Packing Rings are specially designed to solve it for you. Convexly curved surfaces where the rings meet and thinner cross section at the apex of each V cause a flexing action which makes a firm seal on the shaft and stuffing box wall and between rings

R/M Vee-Flex Rings are available in many compositions to meet the hazards of various applications: high temperatures, high pressures, fast cycling, corrosion, or combinations of these.

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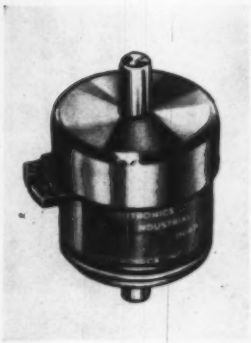

Miniature Clutches

Autotronics Inc., announces an industrial miniature-electro-magnetic clutch designed for commercial applications featuring small size, high performance, servo or face mounting, zero backlash, and priced for industrial uses.

The units, called AIM model C-125, have 1.125 pilot mounting diameters, clutching torque of 40 in. oz, no slip rings, and are completely self contained. When energized the output and input shafts are coupled together: de-energized both shafts are free running. Standard voltage is 24 to 28 vdc.

The firm states the units are applicable to tape recording equipment, calculating machines, coin changers and other automatic controls. **—K-20**

Liquid Metal Pump

A pump for use in high-temperature liquid metal-cooled reactors has been developed by Westinghouse Electric Corp's. atomic equipment dept.

The new pump is designed to circulate liquid metals through the hermetically sealed system of certain types of nuclear power plants. A 15 brake-hp prototype liquid metal pump was tested at temperatures as high as 1265 F, the company reports. After 3500 hr of successful operation at temperatures constantly above 1000 F, inspection proved all parts of the pump to be in excellent condition.

The pump can be supplied in capacities ranging from 150 to 5000 gpm at operating temperatures up to 1600 F.

The firm states that operating temperature of the new pump motor is independent of the temperature of the liquid metal which it circulates, and that the unit can operate in reactor systems where temperatures are higher than the testing temperature of 1265 F. **—K-21**

On the Job

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BUSINESS NOTES
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Air, Oil Valves

Barksdale Valves announces a new series of 0-250 psi manual four-way air and oil valves priced for original equipment manufacturers.

Incorporating the firm's Shear-Seal leak-proof design, which has been utilized to prevent both internal and external leakage, the valves are said to be identically the same in mechanical design as the more expensive high pressure models.

The valves are available in standard 3-position and spring return models to either the center or reverse position. The valves are available in $^1/_4$, $^3/_8$, and $^1/_2$ in. NPT pipe sizes.

The company states that valve characteristics remain the same with minimum flow passage ranging from $^3/_8$ to $^9/_{16}$ in. diam, and rated flow at 20 ft per sec ranging from 7 to 15.5 gpm according to port size, since the flow passages are unobstructed by either spools or poppets. The mechanical parts have been manufactured from stainless steel and aluminum.. —K-22

Crystalline Tubing

Corning Glass Works announces commercial production of tubing and plate to be sold under the Pyroceram trademark. The company has indicated that the tubing, with excellent thermal shock qualities, is currently undergoing tests in heat exchangers.

Other commercial applications of the new material being investigated include bearing parts for high temperature uses, piston heads, precision-made aircraft structural parts, and architectural curtain walls.

Current production schedules on a continuous melting tank call for the tubing with various diameters and lengths up to 10 ft, rod and sheet, as well as sample runs of blown and pressed ware.

Pyroceram 9608, which is currently being produced, is described by the company as a general purpose material.

With a mechanical strength three times that of ordinary glass, 9608 combines great hardness with an extremely low coefficient of thermal expansion up to 1800 F. —K-23

Phil:
Our present piston cups are unpredictable-some hold up well enough, others go to pieces (extruding, usually) in a hurry. How come?
Hal

MEMO
Hal—
Probably sloppy molding. R/M piston cups are precision molded ... you can count on them for consistent top-quality performance, exact fit.
Phil
CLEAN TRIMMING
CLEARLY DEFINED CONTOURS
THOROUGH COMPOUND PENETRATION

You can see the extra quality, the extra performance you get from R/M Piston Cups under close examination. The clearly defined, accurate contours, the cleanly trimmed edges, the thorough penetration of compound through the fabric, all these are signs of a careful, reliable molding job. The results for you are resistance to ply delamination, longer service life, and precision fit.

Your needs are sure to be met by one of the seven R/M styles: Neoprene and duck or Buna-N and duck in three hardnesses—or Buna-N and asbestos.

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Air Hammer

A heavy duty air hammer, Model SP-600, featuring a short barrel for easier operation in blind spots or close quarters, has been announced by Superior Pneumatic & Mfg., Inc.

The unit weighs 3 lb, is only 8 in. long, and is said to be easy to handle. It has a metering trigger that lets the operator control blows from 0 to 3500 per minute with light pressure from one finger. A patented safety chuck locks tools in six different positions. Air consumption is 11 cfm at 90 psi.

—K-24

150,000-Lb Testing Machine

A 150,000-lb universal testing machine, said to be the largest single screw mechanical type ever made, has been developed by Electronics and Instrumentation Div., Baldwin-Lima-Hamilton Corp.

According to the company, the machine can apply tension and compression or alternating loads to a specimen. It is said to be the first mechanical tester of this capacity capable of providing facilities for both standard testing and alternating load work. All measurements are taken by SR-4 devices, and high accuracy is possible in all test setups.

The tester has four principal operating advantages: positive head positioning; easily controlled, constant or variable head speed; direct reversibility for tension or compression; and ability to cycle both load and strain.

The firm says the machine can test practically any material or part which is subjected to sustained or alternating loads and strains. Such parts would include those used in aircraft, vehicles, marine craft, high speed turbines and industrial machinery. Parts requiring testing for aircraft use, for example, include wing struts, flaps, landing gear, ailerons, and engine mounts.

According to the company, the machine incorporates an advanced design innovation for head movement—a single pre-loaded ball and screw mechanism rather than conventional Acme or square thread screws. It is said to be the first testing machine that has employed this mechanism.

The ball and screw permits extending the testing range to 150,000 lb without back lash.

Because of the preloaded mechanical system, there is no lubrication loss and, consequently, no danger of head drift, the company reports. The head is precisely controlled at all times during application of varying or constant strain rates.

The ball and screw reduces friction and increases mechanical efficiency to such a degree that a motor drive one-third the size required for conventional machines may be used, the firm states.

—K-25

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Self-Aligning Precisien Bearing

Fuller Tool Co. announces an entirely precision-ground, self-aligning bearing designed to eliminate backlash. If features a unique interlocking race with 100 per cent contact between race and ball, with tolerances as close as .0002 in.

It is intended for application in actuators and linkage on aircraft, missile, and military assemblies in marine applications and other uses where the elimination of backlash is an important consideration, the firm reports.

The bearing is not swedged; the interlocking race, in which both halves extend slightly beyond center, forms a complete mass when assembled. The company says this feature permits high Rockwell heat treatments on both ball and race and the use of any type material. —K-26

Self-Locking Nut

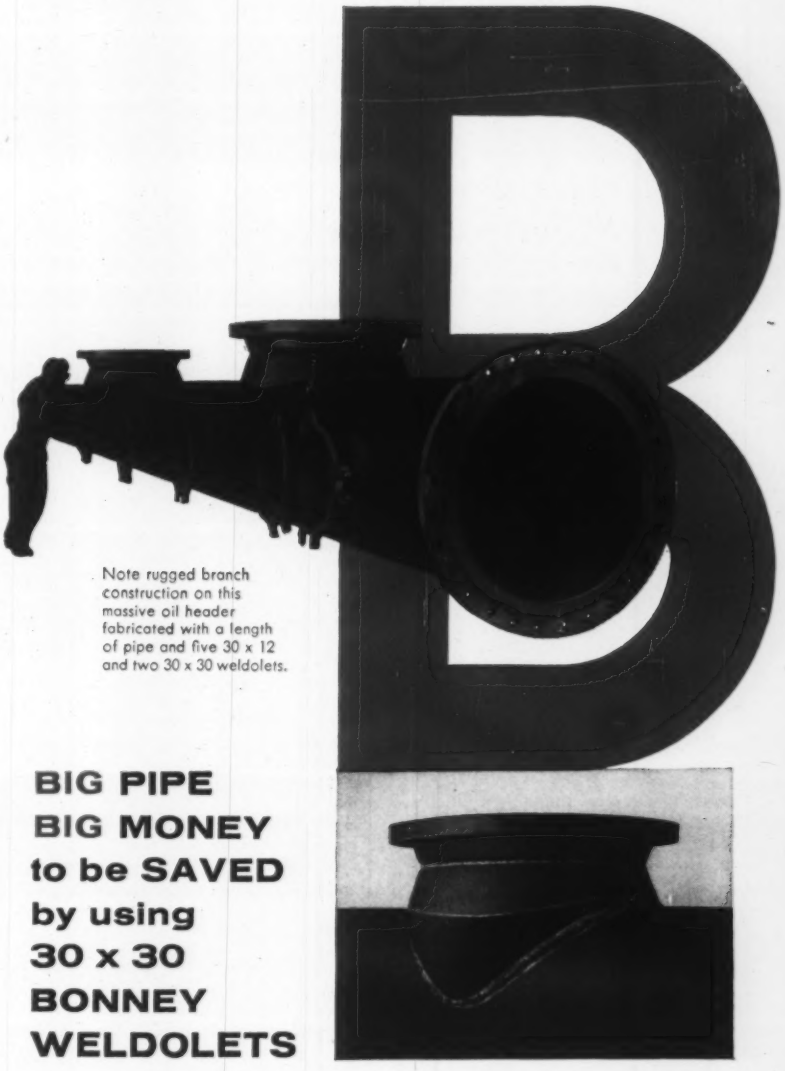
A self-locking nut designed to simplify installation, replacement and maintenance of interior wooden panels in truck and railroad freight cars has been announced by the Elastic Stop Nut Corp. of America.

The nut is made to mount flush with the panel surface facilitating loading and unloading of the freight preventing possible damage to cargo by exposed bolt or fastener, the company reports.

Installation or removal of the panel nut can be quickly made by using a standard double-bladed screw driver type tool in a hand power unit, the firm states. The blades of the screw driver tool fit easily and securely into the .125 in. wide slots in the face of the nut and provide the wrenching action.

The locking insert of nylon keeps the panel nut from loosening on the bolt despite possible loss of bolt tension due to shrinkage or compression of the wood panels. This self-locking action holds the fastener in place under the most severe vibration conditions. The elastic recovery of the nylon insert allows repeated reuse of the fastener with no loss in locking effectiveness.

The new panel nut, Type 3017, is made of carbon steel with a plain finish and is available in $^3/_8$-16 thread size. It is 1 in. in diameter and .265 in. thick. —K-27



Note rugged branch construction on this massive oil header fabricated with a length of pipe and five 30 x 12 and two 30 x 30 weldolets.

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Closer manifolding, ease and speed of field fabrication without header distortion, lower purchase and welding costs are just a few of the profit benefits of header fabrication with Bonney Weldolets. Today there is particular need for reducing costs. Bonney Forge can provide this opportunity for cutting costs in your company. Write, phone or wire for details.

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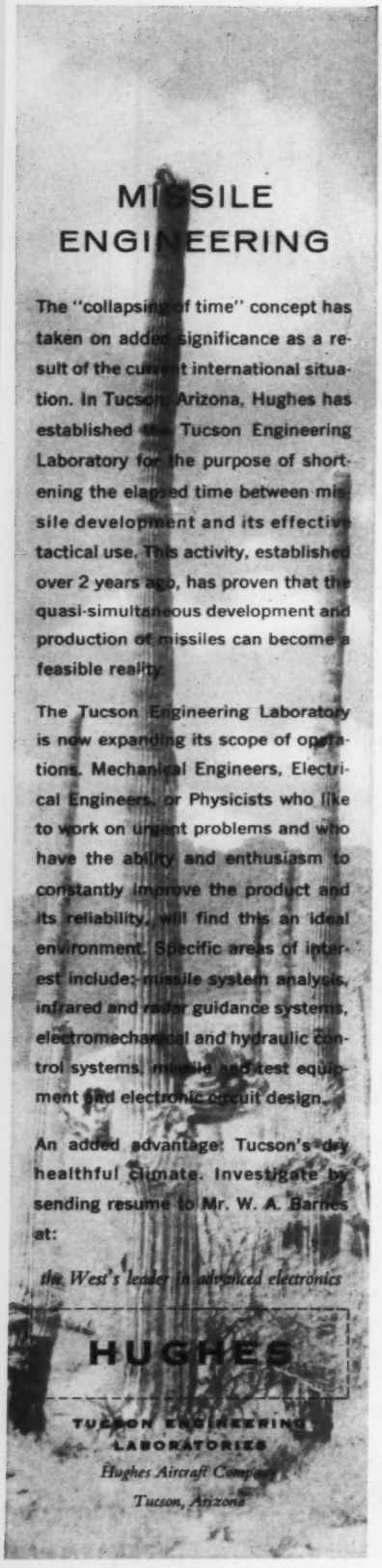
MISSILE
ENGINEERING
The "collapsing of time" concept has taken on added significance as a result of the current international situation. In Tucson, Arizona, Hughes has established the Tucson Engineering Laboratory for the purpose of shortening the elapsed time between missile development and its effective tactical use. This activity, established over 2 years ago, has proven that the quasi-simultaneous development and production of missiles can become a feasible reality.
The Tucson Engineering Laboratory is now expanding its scope of operations. Mechanical Engineers, Electrical Engineers, or Physicists who like to work on urgent problems and who have the ability and enthusiasm to constantly improve the product and its reliability, will find this an ideal environment. Specific areas of interest include: missile system analysis, infrared and radar guidance systems, electromechanical and hydraulic control systems, missile and test equipment and electronic circuit design.
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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Solenoid Operated Lubricator

A compact lubricator that is actuated by a solenoid is announced by Bijur Lubricating Corp.

Known as the Type E solenoid-operated lubricator, the unit has been rated for six million cycles (or about 10 years use). As many as 20 average bearings may be lubricated by a single Type E unit, the firm reports.

Either a three-pint or a six-pint reservoir may be used. With the larger reservoir, automatic warning systems are provided. One, operated by a single-contact float switch, sets off a visible or audible alarm when oil supply is low. Another, operated by a double-contact switch, first gives the alarm and then if oil is not added within a short time, automatically shuts down the machine before all the oil is gone, thus protecting the bearings from running dry.

The solenoid is adaptable to three types of control. A push button or foot switch may be used for manual control. The machine's circuit or else a contact or microswitch governed by the machine's cycle provides integrated automatic control. Remote automatic control is based on operation of an electric timer. With automatic controls, manual control may be used for priming.

Oil is drawn into the unit through a filter and check valve as the solenoid raises a piston against spring pressure. Interruption of current releases the piston, forcing the oil through another check valve and out into the distribution system to the bearings on the machines, where precisely measured quantities of oil are discharged through the firm's meter-units. —K–28

Grinding Machine

A new size, No. 1, has recently been added to the line of centerless grinding machines built by Cincinnati Grinders Inc. The new machine, rated at $7^1/_2$ hp for the grinding wheel drive, has a capacity of 0 to $1^1/_2$ in. diam work.

Principal features include the firm's exclusive Filmatic bearings for the grinding wheel spindle. These bearings, consisting of three segments, are said to automatically adjust for load and eliminate spindle flutter. The grinding wheel spindle is supported in a fixed mounting in the bed casting. A double slide and swivel plate construction between the regulating wheel housing and bed simplifies setups. The regulating wheel and work rest can be positioned individually or together in relation to the grinding wheel, and, through the swivel plate, can be adjusted to compensate for slight errors of alignment in setup or truing, the company reports.

Ways for the regulating wheel pile are lubricated from a central reservoir with manual pump. When the machine is equipped with an automatic infeed attachment, automatic pressure lubrication is supplied for the ways. —K–29

URGENT!

Be sure your company takes advantage of the FREE PRODUCT LISTINGS in the directory section of the 1959 MECHANICAL CATALOG

The editors of Mechanical Catalog are expanding and improving the directory section to make it of even greater service to you . . . of even greater value to manufacturers of products used and bought by mechanical engineers in industry.

Listing forms have been sent to 3,500 companies to enable them to conveniently check off products they wish listed in this valuable reference book. Likely your company has received one of the forms. If it has not been returned to us, you'll do your company and the Society a great favor by expediting its return. If your company has not received a free product listing form, drop us a line and we'll forward one immediately. By all means, be sure your company's products are listed in the directory section of the 1959 MC.

MECHANICAL CATALOG

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alterations
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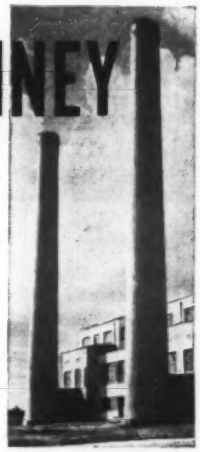

Two Radial Brick Chimneys, 140 ft. x 7 ft. 6 in. Houston, Texas, Municipal Incinerator

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More than a quarter-century of specialized chimney design and building experience enable Consolidated to design and build chimneys which provide the most efficient boiler output with a minimum consumption of fuel.

Consolidated chimneys now in service throughout the United States, Canada, Mexico, and in many foreign countries, have proved so satisfactory in continuous use that additional Consolidated chimneys have been ordered as power requirements have increased.

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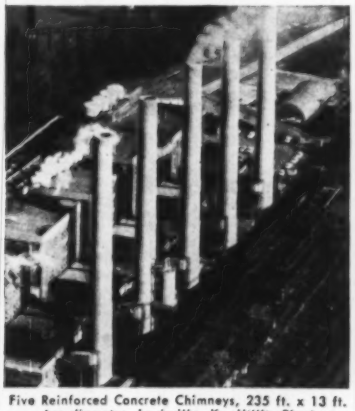

Five Reinforced Concrete Chimneys, 235 ft. x 13 ft. top diameter, Louisville, Ky. Utility Plant

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KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Centrifugal Pumps

A new line of self-priming centrifugal pumps has been announced by the Standard Pump Div. Worthington Corp.

The company states that the pumps feature an exclusive patented recirculation port design which permits rapid priming and renewal of internal clearance. The new pumps are manufactured in sizes ranging from $1^1/_2$ to 8 in. suction and discharge. The two smallest sizes are of aluminum construction. All internal wearing parts are iron and steel.

The pumps are available as engine driven units; close-coupled, monobloc motor driven units; or conventionally coupled motor driven units. **—K-30**

Parts-Handling Unit

A high-capacity demand-feed storage unit for parts that can roll has been developed by Gear-O-Mation Div., Michigan Tool Co.

Designed for use in automated processing lines, the new unit basically consists of 'zig-zag' gravity part-retaining tracks, fed from integrated parts elevators. Capacity of the unit ranges from 1500 parts ($2^1/_8$-in. diam × $1^1/_8$-in. wide) to 3000 ($1^3/_8$-in. diam × $1^1/_8$-in. wide) parts.

The units are designed to insure production continuity of a line, particularly during tool changes on any part of the line, by providing a true demand-feeding system.

The unit has a by-pass track that permits direct passage of parts through the unit. It also features built-in counters (in the control panel) to provide a running parts inventory. Two five-digit counters are used—one tabulating "parts in," the other "parts out". They can be manually reset to zero whenever practical.

The construction is of $^1/_4$-in. plate steel welded into a combined frame and shell. All tracks and elbows are made from die-stamped steel. All controls are the heavy-duty type. **—K-31**

Ceramic Magnet Pulley

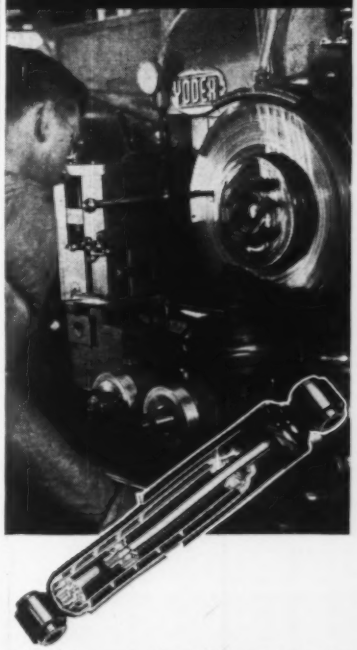
Stearns Magnetic Products announces a magnetic pulley in which Indox V ceramic permanent magnets energize it to produce a powerful magnetic field to remove troublesome tramp iron from fast-moving conveyor burdens.

The new permanent magnet pulley is reported to equal the performance of electromagnetic types, and to be superior to conventional permanent magnet models.

The unit has a radial pole design of the magnet assembly which boosts holding efficiency without the disadvantages of electrical power supply.

Series 410 permanent magnet pulleys and Series 710 for deeper conveyor burdens are available in standard widths from 12 in. up, and in diameters of 12, 15, 18, 20, and 24 in. **—K-32**

Monroe Shock Absorbers rely on Precision Performance of YODER TUBE MILLS



After 15 years of continuous operation the Yoder Type-M Electric-Resistance Weld Tube Mill shown here, is still producing precision tubing for the Monroe Auto Equipment Co., Monroe, Michigan. Yoder produced tubing is the basic component of the famous "Monro-Matic" shock absorber. Measuring $2^1/_{64}$" outside diameter (plus several other sizes) the tubing is made from 22 gauge strip in one continuous operation . . . it is automatically cold-roll formed, welded and cut to pre-determined lengths.

This typical installation of a Yoder tube mill exemplifies the accuracy, dependability and production economies of Yoder-made tubing. If your business requires pipe or tubing, ferrous or non-ferrous, in sizes from ¼" to 26" diameters, there is a Yoder mill designed to produce it economically, efficiently and accurately.

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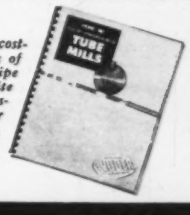

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Flow Divider

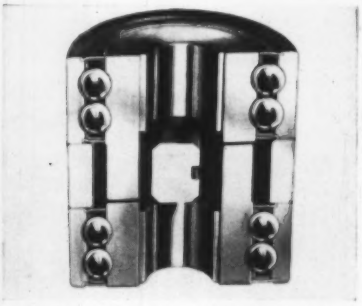
Fluid Controls Inc., announces a flow divider designed to divide the flow from a single pump into two equal parts.

The device is said to be accurate to within 10 per cent of the total flow, and can be used to combine two flows into one with the same degree of accuracy.

The flow divider is normally used where two hydraulic cylinders are to be moved simultaneously and parallel to one another, the company explains.

The device operates as a pair of pressure compensated flow regulators to keep the pressure drop equal across two orifices. As the flow increases through one orifice, the pressure difference between the two causes a sliding spool to shift over the orifice and equalize the flow.

Available in two sizes—1 to 4 gpm and 3 to 10 gpm—the unit is equipped for $^3/_8$ in.-pipe size and is designed for 2000 psi working pressure. **—K-33**



One-Way Torque Bearings

Standrad bearing assemblies for positive control of angular shaft position are being produced by Ann Arbor Bearing & Mfg. Co. According to the firm, they prevent independent movement of a driven shaft except when rotation is produced by a drive shaft.

Both shafts insert in the bearing assembly, the company explains. Two conventional double row ball bearings, with extended inner rings, are used on either end. Between the two is a lock ring, containing a spring-loaded lock bar.

Drive shaft rotation compresses the spring and releases the lock bar. This permits rotation to be transmitted to the driven shaft. However, the firm states, any independent driven shaft movement will cause the lock bar to wedge tight against the fixed outer lock ring. Driven member lash is less than 2 deg; drive shaft lash is less than 4.5 deg.

Applications cited by the company include steering mechanisms, aircraft controls, hoists, derricks, punch presses, and ordnance turrets. Standard torque ratings range from 50 to 2600 lb-in. Bearings are machined to ABEC-1 or to customer specifications.

—K-34

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Control Valve

A pressure compensated flow control valve said to also correct for flow variations due to fluid temperature changes, is announced by Vickers Inc., Detroit 32, Mich. This new valve replaces 12 models in the 5 to 1000 cu in. per min flow range, the firm reports.

Average flow variations, due to temperature changes, have been reduced to approximately 1/4 the variation found in current models, it is stated. A single adjustable throttle is used for all flow rates from 5 to 1000 cu in. per min, and allows a finer flow rate adjustment than any of the six throttles previously required to cover this flow range. Minimum and maximum metered flows compare favorably with the old models, the company says.

The new valve has an integral check valve to permit reverse free flow. Its maximum reverse flow is rated at 1400 cu in. per min. Flow rate adjustment is said to be tamperproof. A set screw prevents further adjustment of the selector knob and a cover over the set screw can be locked in place with a key. The valve's design configuration eliminates the necessity of an external drain. It is available for either gasket or subplate mounting and is interchangeable with the old models except for the drain connection. New subplates will not have a drain connection.

An optional anti-jump feature may be incorporated in the temperature compensated flow control valve, which reduces the hydrostat inlet opening and decreases the volume of oil passed with sudden surges of inlet pressure, the firm adds. **—K-35**

Micro-Miniature Relay

Development of a new hermetically-sealed micro-miniature relay for use in printed circuit equipment has been announced by General Electric's Specialty Control Dept.

Designated Type GS, the new double-pole, double-throw d-c relay is an improved version of the firm's G-200 micro relay which has been on the market for two years.

According to the company, the unit is tailored to the new grid-spaced concept in printed circuit layout. The 0.2-in. spacing of relay terminals conforms with the 0.1-in. spacing on printed circuit boards. Simplified plug-in positioning and placement of relays are said to have been made possible by development of the new relay.

The double-pole, double-throw unit has a coil resistance of 600 ohms for 26.5-v d-c circuits and will operate over a 190-deg ambient temperature range from −65 to 125 C.

The relay has a contact rating of 3 amp resistive load at 28 d-c or 115 v a-c for 100,000 operations and a rating of 2 amp resistive load at the same voltages for 500,000 operations. **—K-36**

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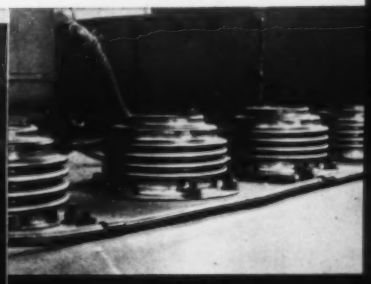

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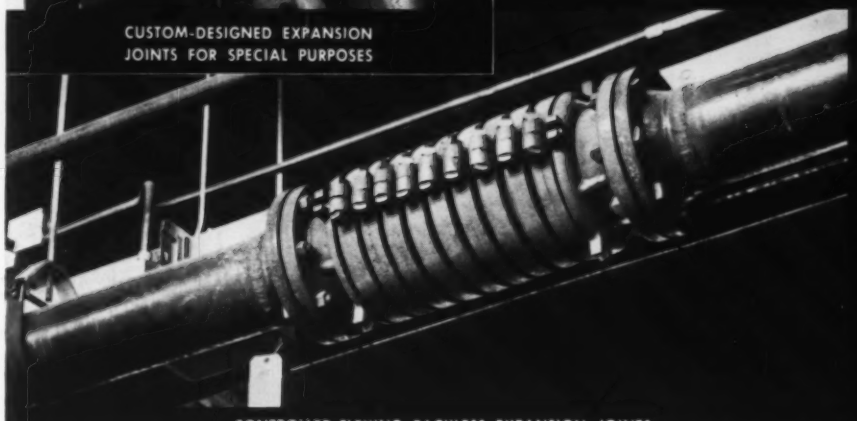

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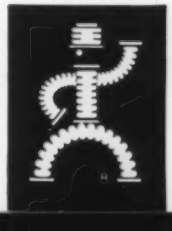

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

High-Flow Solenoid Valve

The first model of what is described as a compact, inexpensive solenoid valve line that permits full flow of air, water, oil and other common media is announced by Skinner Electric Valve Div.

Named the L series, the new valves are 2-way, normally closed, pilot-operated. The first valves introduced weigh $1\frac{3}{4}$ lb and are $3\ \frac{31}{32}$ in. high. According to the company, they provide a $\frac{1}{2}$ in. orifice with either $\frac{3}{8}$ or $\frac{1}{2}$ in. pipe taps.

The firm states that only a small area of the new, completely supported diaphragm is exposed to pressure. A soft, synthetic insert is said to be shockproof and provide bubble-tight operation.

The forged brass body provides low porosity and dense metal structure to prevent leakage in even the most rugged applications. Internal parts are made of stainless steel to prevent rusting, clogging and contamination. **—K–37**

Roof Ventilators

Trane Co. announces a new line of modern contoured, roof-hugging axial roof ventilator air moving units for exhaust or supply service.

Typical applications for the ventilators are on factories, warehouses, mills, and other buildings with large, open interior areas, the company states. Included are hooded and vertical, exhaust and supply, and direct and belt driven units to handle a variety of ventilation purposes.

Hooded units, manufactured of steel, provide an attractive, minimum height silhouette and are designed to be weatherproof and satisfy blackout requirements.

Vertical units exhaust smoke, fume and gas-contaminated air high above the roof to prevent re-entrance to the building or damage to the roof. Construction is of heavy gage steel.

Higher operating capacity with lower power consumption is said to be provided through the use of a special axial fan that has up to 17 per cent greater peak static efficiency than conventional wheels, a streamlined inlet opening for uninterrupted air flow, and because motors and mounting brackets are located below the fans on all units, thereby reducing obstruction to the leaving air stream.

Vertical exhaust units have a sloping type butterfly damper arrangement. In closed position, the dampers slope downward at a 26 deg angle for proper drainage. An extruded plastic seal around the damper seat eliminates the possibility of air leakage. The dampers may be equipped with an optional high temperature safety device for automatic opening in case of fire, the firm states. **—K–38**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Teflon Seal Assembly

Skinner Seal Co., has announced a new "Sombrero" seal designed to reduce oil leakage and eliminate oil waste caused by the reciprocating of valves subjected to alternating pressures in applications such as the intake and exhaust valves for high compression internal combustion engines.

The seal assembly consists of a housing, a seal of Teflon material and a garter spring which contracts against the Teflon which, in turn, seals against the valve stem and the valve guide. —K-39

Multi-Purpose Solenoid Drives

Valcor Engineering Corp., announces a line of low-cost, multi-purpose solenoid valves, the SV-4900 series.

The 2-way, normally closed, valves feature a plunger seal design with a soft rubber seal said to assure-bubble-tight sealing. The valves have stainless steel internal construction and brass body. They are 2.35 in. high by 1.50 in. wide and are available with $^{7}/_{64}$ orifice rating 130 psi max and $^{5}/_{32}$ rated 60 psi max.

The valves are designed for general usage with water, air, steam, inert gases, petroleum and vegetable oils, gasoline, kerosene, and many other semi-corrosive media. —K-40

Enclosed Switches

Micro Switch Div. Minneapolis-Honeywell, has announced an improved design for its line of Type E general-purpose enclosed switches.

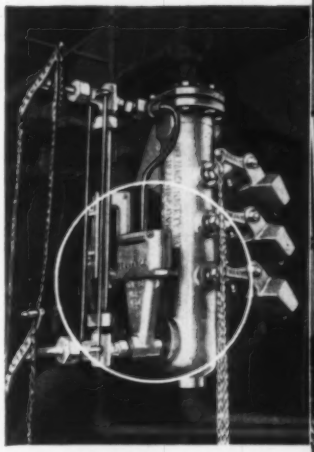
The switches feature a compact enclosure that provides for easy installation, with a design that exposes the inside switch terminals for easy wire connection by separating the enclosure into two halves, the announcement said.

A second major improvement is a new one-piece molded neoprene insulator-seal that is cemented permanently into the bottom half of the enclosure. This replaces the wrap-around insulator and separate gasket formerly used to simplify handling and improve the insulating and sealing qualities of the switch, the firm states.

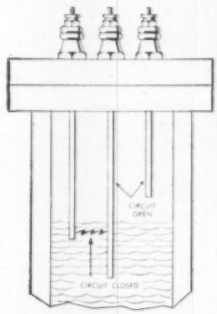
Other improvements of the new switches designated Type E6 for side mounting and Type V6 for bottom mounting, include a more rugged housing, a hex-shaped conduit hub and improved appearance.

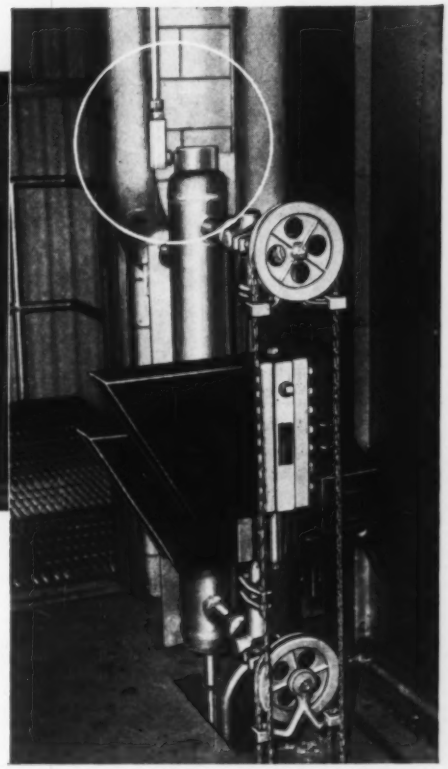
The new enclosure is available in five different integral actuator designs and in side- or bottom-mounted types. All types are interchangeable with the company's older Type E and V designs.

Standard types of the new switches have single-pole double-throw contact arrangement. Their UL electrical rating is listed at 15 amp 125, 250, or 460 v-a-c; $^{1}/_{2}$ amp 125 v-d-c; $^{1}/_{4}$ amp 250 v-d-c. The basic switching unit is replaceable. —K-41



Simplest type of Levalarm, the EA15, for fuel cut-out or/and low water alarm.





The EA18 Levalarm on this water column provides high and low alarm, fuel cut-out, pump start and pump stop.

Your boiler water "calls the signals" through the Reliance LEVALARM® system

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3. To provide two-stage control by opening one circuit on a rise and a second circuit on a further rise.

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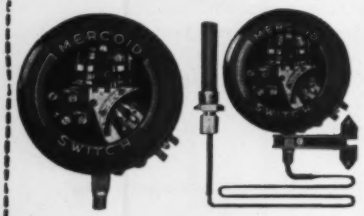

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Vibration Pickups

Three new vibration pickups, said to be particularly suited for in-flight monitoring of jet engines and other constantly vibrating equipment such as motors and generators, are now available from Consolidated Electrodynamics Corp.

The firm states that the units are operable over the temperature range of −65 to +500 F, and will perform with precision in oily or corrosive atmospheres. Sand, dust, or fungus cannot penetrate their hermetically sealed interiors, the company says.

Externally, the three are identical, but internal construction and damping differ slightly to allow horizontal mounting of Type 4-121, vertical mounting of Type 4-122, and omnidirectional mounting of Type 4-123. The 4-121 and 4-122 will minitor turboprop vibrations in the range of 15 to 2000 cps. The 4-123, with its 45 to 2000-cps operating range, is designed for jet-engine monitoring where the lowest frequency encountered is about 50 cycles.

Because of their light weight (only 4.25 oz each, including connector) the pickups will not affect the vibration characteristics of the equipment under test, the firm reports. All three are air damped, and, it is stated, because of their unique internal construction, damping is practically unaffected by temperature changes within the operating range. **—K–42**

Sensing Probe

Aerotech Specialties, Inc., Glastonbury, Conn., announces a miniature probe for measuring flow velocity, total and static pressure and flow direction in three dimensions (two independent direction angles).

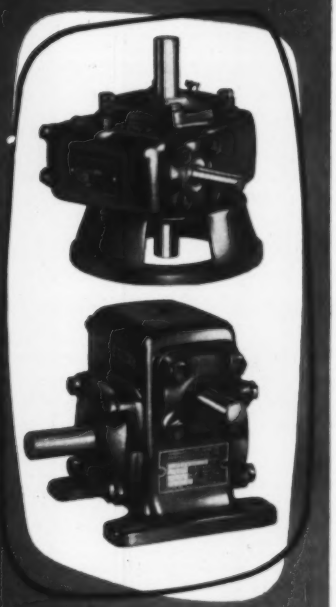
For liquids and gases, each probe is individually calibrated. The calibration is constant at all velocities for liquids but varies with Mach number for gases above Mach 0.25, the firm reports.

Six pressure holes in the tip are set in recesses to minimize damage in handling and to provide direction sensing properties. The probe is rotated until pressures P_2 and P_3 are equal. This measures the yaw angle of flow directly. P_1, P_2, P_3 and P_4 are then read, by finding three pressure ratios and referring to the calibration curves total and static pressure and pitch angle are found.

The probe is made of stainless steel with a variety of stem lengths and take-off adapters, silver-soldered for use up to 1000 F or welded for use to 1500 F. The smallest size fits through a $\frac{1}{8}$ in. diam hole, other sizes up to $\frac{1}{4}$ in. are also available.

This type has been used successfully in gas turbine development by taking traverses between rotor and stator blades to measure actual flow velocities and angles under operating conditions, the company says, and has also found applications in mapping streamlines in elbows and inlet sections where the flow is not two-dimensional. **—K–43**

PERFECTION
worm gear
SPEED REDUCERS



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5 to 1 to 60 to 1

Perfection Worm Gear Speed Reducers by American Stock Gear are available in 9 complete series with ratios ranging from 5 to 1 to 60 to 1 for input revolutions ranging from 300 per minute to 1800 per minute. Speed Reducers are furnished in horizontal right angle drive with worm in either top or bottom position and are also furnished in vertical right angle drive. Integral worm and shaft is made of selected quality, case hardened alloy steel. Threads are precision ground and accurately mated with worm gear. Shafts are mounted in Timken anti-friction roller bearings. Oil seals are of selected cirvis leather which assures maximum sealing effect. Available through your nearest American Stock Gear Distributor.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Automatic Wave Analyzer

An automatic wave analyzer that is a special-purpose analog computer for directly converting data obtained in studies of noise, vibration, shock and other electrical wave phenomena has been introduced by Davies Laboratories Div., Minneapolis-Honeywell.

The analyzer provides frequency analysis from 3 to 10,000 cycles per second. According to the firm, it produces a highly accurate analysis in permanent record of any repetitive complex wave form. The analyses are plotted as either amplitude vs. frequency (Fourier), power vs. frequency, or amplitude of a specific frequency vs. time. Cross spectral or transfer function data is provided when two channels are used.

Frequency accuracy is within 1 cps from 3 to 50 cps and 2 per cent from 50 to 10,000 cps. Amplitude accuracy is ±5 per cent of reading or ±0.2 per cent of full scale, whichever is larger.

Components of the analyzer, housed in a single enclosed relay rack, include an oscillator-controller, filter-detector, demodulator, main power control panel, 11-in. log scale recorder, and regulated plate and filament supply voltages.

Automatic switching input panels are available as an accessory item to permit handling and analysis of as many as 14 channels of data sequentially. In addition, the analyzer can be provided with up to six channels for simultaneous analyses. —K–44

Dispersion Mill

A multistage dispersion mill said to represent a new and improved method for wet milling and grinding, homogenizing, dispersing, emulsifying and extracting, is announced by Pfaudler Co. Div., Pfaudler Permutit Inc.

The new mill serves as its own pump, drawing material down through a multistage grinding area to pre-set sizes and then ejecting the product under pressure. It operates either on a continuous through-put basis so that it can be tied into continuously operating production lines or it can be used for batch operations with or without re-cycling facilities, the company reports.

Basically, the PUC dispersion mill consists of a conical ring shaped grooved stator having from two to five grinding stages, depending upon mill model. Within this stator turns a grooved rotor at high speed having corresponding multiple grinding stages. The rotor and stator are arranged in a manner to form a milling gap or slit between the two parts, so dimensioned and positioned that the gap decreases in a downward direction. This gap can be regulated for various micro clearance settings by a calibrated adjustment device. Crushing, grinding, and homogenizing are performed by mechanically and rhythmically produced vibrations of high frequency within the grooved milling stages. —K–45

PUMP CLINIC

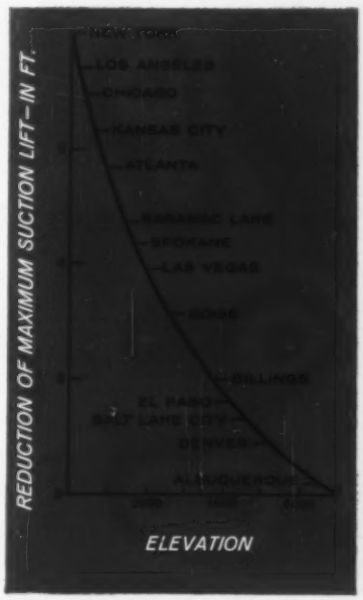
altitude:

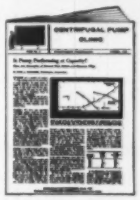
ITS EFFECT ON SUCTION LIFT

Atmospheric pressure — which causes liquids to flow into pump impellers—is reduced by about one inch of mercury for each 1,000 ft. of elevation. As a result, the maximum suction lift of any pump is correspondingly reduced if used in higher altitudes.

When buying a water pump, always specify *altitude* in addition to suction conditions. Your Worthington representative can then select a pump with the correct suction characteristic to operate properly at the required altitude.

This graph shows how suction lift is affected by altitudes of various U.S. cities.





For assistance in solving problems in the operation and maintenance of centrifugal pumps and for useful facts and figures on their selection and installation send for our handy Centrifugal Pump Clinic folder. Write: Worthington Corp., Section 21-1, Harrison, N. J.

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For each of the manufacturing methods there is a compilation of the basic physical characteristics to be considered and the general advantages and limitations usually encountered. Concise, parallel data concerning the suitability of various metals for each process, and the natural tolerances on size and surface finish obtainable, assist in evolving designs that meet all functional requirements consistent with economical production techniques.

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KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Solenoid Valve

Controls Co. of America announces development of a new solenoid valve, Model 291.

Available in brass or stainless steel, the new 2-way valve can be used for air, gas, water, oil, and all common industrial fluids, the firm states. It was designed for specific use in tight equipment corners and crevices where a compact normally closed valve is needed to control flow. **—K–46**

High-Speed Scanner

Model SC2 scanner, described as an instrument capable of scanning 500 pairs of input connections at a rate of 50 pairs per second, bringing the selected pair to a set of output terminals, has been announced by James Cunningham, Son & Co.,

The instrument is designed for scanning thermocouple voltages, strain gage voltages, analog computer outputs, and in general those applications where a high quality contact, together with high scanning speed, are paramount considerations, the firm reports.

The scanner is designed around the firm's Type F crossbar switch. These switches are operated from Burroughs magnetic-beam-switching commutators which are buffered with RCA 2N301 transistors. The company states that, in order to satisfy the speed requirement, a novel type of logic combining the advantages of electronic circuitry with those of the crossbar switch has been incorporated. The combination is said to result in a high-speed scanner of much longer life than rotary sampling switches and considerably higher speed than stepping-switch scanners. The contact characteristics of the crossbar switches are such that extremely low-level signals impressed on this scanner will be reproduced faithfully, the company says.

While the scanner is designed to operate at a speed of 50 pulses per second, with a minimum dwell time of 5 milliseconds at each selected pair of points, both higher and lower repetition rates are possible. As the repetition rate is decreased, the dwell time is correspondingly increased.

The unit will step with positive pulses of at least 25 v amplitude and a rise time between .02 and 1 microsecond. The duration of the pulse is not critical as long as it is greater than .1 microsecond.

In addition to the selected pair, an end-of-scan indication is provided. This is a contact which closes after the last point has been scanned, and can be used to actuate external equipment to interrupt the flow of stepping pulses to the scanner. At the moment the contact closes, the scanner is made to return to a Home position exclusive of the 500 pairs of scanned points. It is also possible to arrange homing to occur only when a pushbutton is depressed, with the scanner stopping after the 500th point is scanned, and remains on this last point.

—K–47

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Small Pipe Reamer

Toledo Pipe Threading Machine Co., announces a new ratchet pipe reamer, said to be especially effective for small pipe.

Its 7-flute design removes chips better and also improves the cutting qualities, according to the manufacturer, and it is designed for fast reaming while eliminating gouging. The unit, No. 182, feeds into the pipe with only light pressure, is easily resharpened, and has a pipe capacity of 1/8 to 2 in.

—K–48

Memory Device

Development of a super high speed memory device, said to respond in a hundred millionth of a second, is announced by International Business Machines Corp., 590 Madison Ave., New York 22.

The device, which utilizes a miniature printed circuit of metallic lead at temperatures close to absolute zero is believed by the firm to hold great promise for use in high speed, high capacity electronic computers of the future.

It is based on the unusual properties of special superconducting materials which offer no resistance to the flow of electric current at extremely low temperatures. Even after the source of electricity is removed, current will continue to flow without diminution, the company states. An additional advantage of the device is that it requires only about a third of the current needed to drive the ferrite memory units now widely used in electronic computers, while providing an increase in speed of about a hundred times.

—K–49

Flange-Type Collars

A new flange-type collar for use with the firm's fasteners is now available from Huck Mfg. Co.

Designated the 3LC flange collar, the new configuration is said to broaden the design potential for the Huckbolt fastener, permitting use in oversize hole applications.

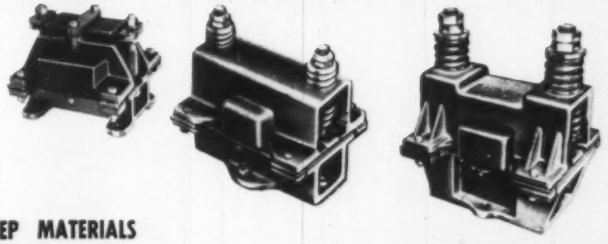
The new collar also provides improved bearing in wood-to-metal, wood-to-rubber, and wood-to-fiber applications, the company states, pointing out that the flange eliminates any tendency to overswage during installation and prevents crushing, extruding, or deforming of the surfaces being joined. The new collar design is installed with standard Huck power tools.

The collar is available in 6061 aluminum alloy (bright finish), 6061-T67 aluminum alloy (dull finish) or C1006 mild steel (plated if required). It covers a range of sizes for use with 3/16-, 17/64-, 5/16-, 3/8-, and 17/32 in. nominal pin diameters. Flange diameters for these sizes are 3/8-, 1/2-, 5/8-, 3/4- and 1-in., respectively.

—K–50

SYNTRON Pulsating Magnet

BIN VIBRATORS



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SYNTRON Bin Vibrators are built in a wide range of types to fill every need from a cubic foot hopper to large bins and bunkers.

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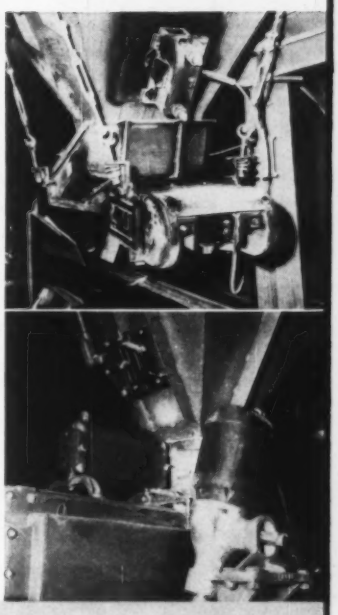

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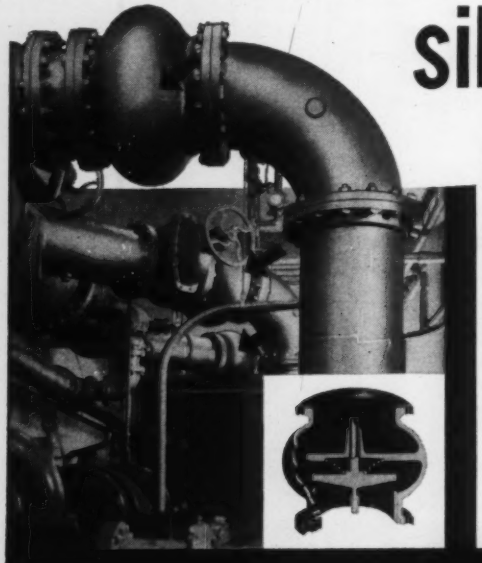

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Globe type for 3" to 24" lines.

Center-guided type for lines from 1" to 10".

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Write for Bulletins No. 654 on the Valves; No. 851 on Cause, Effect and Control of Water Hammer

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Waterproof Electrical Switch

Recora Co., announces a new type of electrical foot switch under the tradename Neptune.

The firm says the switch is completely waterproof so that it can be submerged in water for either operation or cleaning.

The unit—less than $1/2$ in. thick—is designed especially for use in control and low power circuits. It can be used on electrically operated equipment under the most severe environmental conditions, the firm states. The switch electrodes are embedded in a flexible vinyl plastic. Standard switches are available in four colors—brown, blue, green, gray—and can be manufactured in any other color. **—K-51**

Submersible Pump

A pump designed to function effectively on heavy-duty water-pumping operations where dirt, grit or other solids are contained in the water, has been introduced by Sumo Pumps, Inc., Brown House Rd., Stamford, Conn.

It is called electrical submersible drainer pump, and was designed and built to handle water containing up to 20 per cent solids.

The pump is adapted for filter screen sump service, dewatering of mines and quarries, supplying river water intake for industrial plants, pumping or shifting liquid cargoes aboard vessels, draining basements or excavations, removing mucky water from construction jobs or for flooding operations, the firm states.

The pump operates either partly or completely submerged. A built-in thermostatic cut-off protects the motor against damage from overheating, obstructions or overloading. A built-in automatic reset restarts the pump when obstructions are removed or overloading is relieved.

Its motor operates in a factory-sealed oil bath. It is cooled by discharge water. This heavy-duty, squirrel cage, three-phase 60-cycle submersible type motor is rated at $7\frac{1}{2}$ hp. The single-stage centrifugal type pump has a closed impeller mounted directly on the motor shaft. Specially designed back blades keep foreign matter, from the motor seal, it is reported. A $3/8$-in. mesh stainless steel screen protects the pump inlet.

The pump has a capacity of 460 gpm at 15 ft head. With a 70 ft head, the pump will handle 145 gpm. The unit weighs 238 lb. It can be used for portable service or permanent installations, the company states. **—K-52**

For Consulting Engineers Turn to Page 228

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Standard Feeder Unit

A new standard automatic unit for feeding heavy flat strip stock to presses is announced by Press Automation Systems, Inc., 25418 Ryan Rd., Centerline, Mich.

It is described as a portable, plug-in package automation unit designed to handle strip stock of thicknesses beyond the capacity of conventional roll feeds and straighteners. The feed unit is said to be adaptable to single-operation or progressive dies.

The strip stock is rolled manually into a preload station and automatically lowered to a feeding station by air-cylinder controlled arms. The sheet of strip stock is fed into the press by a reciprocating mechanism having mechanical grippers. The stroke of the feed mechanisms is adjustable to meet a variety of pressroom applications.

According to the company, the electrical controls in the unit enable it to be tied into the press cycle to provide a fully automatic feeder arrangement. The feeder is about 6 ft high overall. It is approximately 3 ft wide. Overall length depends upon the lengths of strip stock to be handled.

—K–53

BUSINESS NOTES

Applied Research Laboratory

Westinghouse Electric Corp. has established in Baltimore Md., a new applied research laboratory for the development of radically new electron devices.

The laboratory will develop advanced types of electron tubes, solid state devices, microwave tubes and information storage tubes. The company states that it hopes these new devices will enable future electronics systems to perform functions heretofore considered impossible.

New Office Building

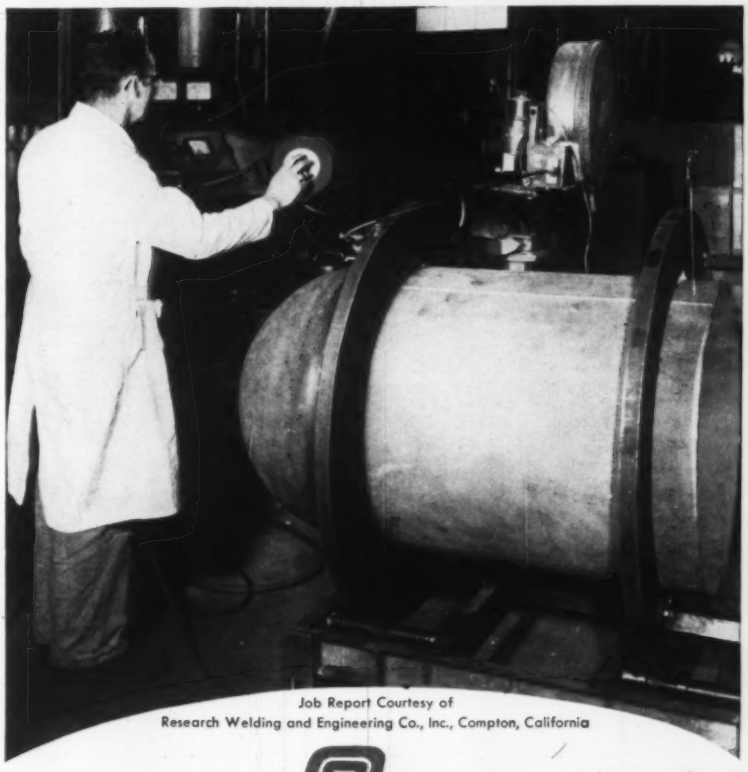
American Brakeblok Div., American Brake Shoe Co. has moved into a new headquarters office building at Troy, Mich.

The new building houses all administrative and sales functions of Brakeblok, and contains regional sales offices for these Brake Shoe divisions: Electro-Alloys, Kellogg, National Bearing, and Denison Div.

New District Office

De Laval Separator Co. announces the opening of a new district office at 121 Coulter Ave., Ardmore, Pa. Mr. George G. Teren, Jr., formerly a sales engineer working out of De Laval's Pittsburgh office, will take over as manager of the new district office.

Weld from one side only . . .
Get X-ray quality welds



Job Report Courtesy of
Research Welding and Engineering Co., Inc., Compton, California

USE THE ARCOS EB* WELD INSERT

This welded missile tank had to weigh less than 600 pounds and yet contain air under pressure of 3,000 p.s.i. Arcos EB* Consumable Weld Inserts were used in automatic inert gas arc welding of the dished heads to the tank body. The inserts saved weight by eliminating back-up rings. They also allowed welding to be done conveniently from one side only and produced 100% x-ray quality root passes. Chromenar CMV coiled wire for submerged arc welding was used to complete the welds. After heat treatment the welds matched the base metal, with tensile strength in excess of 200,000 pounds p.s.i. Whenever your job requires a proper balance of weld metal properties, don't guess—use Arcos. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

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Here's the Great Combination for those...

Medium Pressure Boilers

(up to 150 lbs. psi.)

The No. 150 controls the boiler feed pump the one right way—directly from the boiler water level. Holds boiler level within close limits to assure maximum steaming efficiency and fuel economy. Has extra switch which provides circuits for cutting off burner and sounding alarm in case of low water emergency. It's the most widely-used, time-proved control of its kind.

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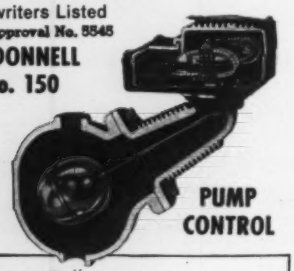
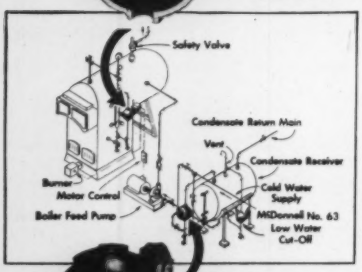
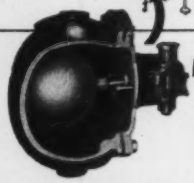
McDONNELL No. 150



PUMP CONTROL





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Adds water to condensate receiving tank whenever necessary to make up for any deficiency in returns. Large feeding capacity meets any sudden boiler demand for water. Needle and seat are stainless steel assuring powerful drip-tight closure. For tank pressures to 35 psi., supply pressures to 100 lbs.

Write for simple installation and wiring diagrams

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3510 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

McDONNELL

Boiler Water Level Control and Safety Devices

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Adds to Bearing Plant

Shafer Bearing Div., Chain Belt Co. has begun operations in a new million-dollar addition to its plant in Downers Grove, Ill.

Located on a 47-acre site two miles west of Shafer's former facilities, the new plant, with its addition, affords expanded production of its present line of industrial and aircraft roller bearings, the company reports. With the 88,000 sq ft addition, the firm will have 121,000 sq ft of office, manufacturing and processing space. The addition includes a general office, machine shop, grinding and heat-treating department. Raw material stores, receiving, shipping and automatic departments were part of the plant facilities finished in 1956.

Distributors

Yale & Towne Mfg. Co. has appointed two new distributors for its Trojan line of tractor shovels.

Spartan Equipment Co., 1922 Bancroft St., Charlotte, will be the distributor for North Carolina, and Craig Taylor Equipment & Supply Co., 322 Concrete Ave., Anchorage, Alaska, will be the distributor for the Territory of Alaska.

Gear Plant Expansion

Illinois Gear & Machine Co. announces completion of a new plant expansion program at the company's South Works.

The principal feature of the program is a heavy machinery building, 300 × 80 ft with railroad track through the center. The building has a double crane with a lifting capacity of more than 50 tons. The building houses special, heavy gear manufacturing equipment, built to the company's requirements for manufacturing gears of unusual size and accuracy.

LATEST CATALOGS

Engines, Machinery

A 12-page brochure containing descriptions and illustrations of each major type of the machinery it produces is available from Nordberg Mfg. Co.

Latest designs of its diesel, Duafuel and spark-ignition gas engines are shown and the bore, stroke, and horsepower range of each is given. Symons crushers and screens are shown in block-out photographs and the principal features and capacities of each are included in the accompanying text. Grinding mills, rotary kilns, and mine hoists are described, along with 18 railway track maintenance machines. **—K-54**

To the talented engineer & scientist

APL OFFERS GREATER FREEDOM OF ACTIVITY

APL has responsibility for the *technical direction* of much of the guided missile program of the Navy Bureau of Ordnance. As a result staff members participate in assignments of challenging scope that range from basic research to prototype testing of weapons and weapons systems.

A high degree of freedom of action enables APL staff members to give free rein to their talents and ideas. Thus, professional advancement and opportunities to accept program responsibility come rapidly. Promotion is rapid, too, because of our policy of placing professional technical men at all levels of supervision.

APL's past accomplishments include: the first ramjet engine, the Aerobee high altitude rocket, the supersonic Terrier, Tartar, and Talos missiles. Presently the Laboratory is engaged in solving complex and advanced problems leading to future weapons and weapons systems vital to the national security. Interested engineers and physicists are invited to address inquiries to:

Professional Staff Appointments

The Johns Hopkins University
Applied Physics Laboratory

8607 Georgia Avenue, Silver Spring, Md.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Piston Ring Replacements

An eight-page brochure covering the replacement of piston rings has been published by Piston Ring and Seal Dept., Koppers Co., Inc.

Procedures for checking pistons and cylinders are included with suggestions on the installation of new rings. Clearance tables for compressors and engines are given.

—K-55

Hand Hoists

Hand hoists, available in 17 different lifting capacities from $^1/_2$ to 50 tons are described in an eight-page bulletin prepared by Wright Hoist Div., American Chain & Cable Co.

Bulletin DH-164-C gives data on such features as the units' design, specifications, clearances, and dimensions. —K-56

Vacuum Pumps

High vacuum diffusion and booster diffusion pumps are the subject of a 12-page bulletin issued by NRC Equipment Corp.

Outline drawings, tables, and large scale speed curves present physical and operating specifications for both mercury and oil pumps with speeds ranging from 10 to 11000 cfm. Through-put curves of diffusion, booster diffusion and mechanical pumps are displayed on a common grid to aid in selection of high vacuum pumps and matching mechanical pumps. —K-57

Rubber Components

A six-page bulletin outlining its facilities and capabilities in the manufacture of rubber and plastic components is available from Ohio Rubber Co.

Bulletin 715 pictures and describes typical products of natural rubber, synthetic rubber, silicone rubber, polyurethane, and flexible vinyl, in the form of molded and extruded parts, and components made of rubber bonded to metal or other materials.

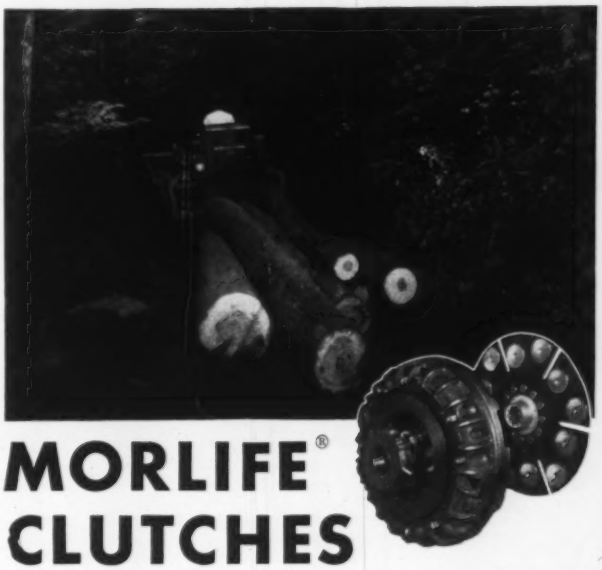
—K-58

PAST EXAMINATIONS
for Professional Engineers given by New York State

This pamphlet contains the questions given in 1952–1956 examinations. They cover problems in structural planning and design, in practical applications of basic engineering sciences, and the more advanced and specialized problems in practical applications of engineering principles and methods.

$2.00 (20% Discount to ASME members)
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39th S., New York 18, N. Y.

ROCKFORD



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Provides Easy Operation by Reducing Hand Lever Pull 50%

Compared to previous type clutch facings, Morlife® Clutch facings reduce hand-lever pull up to 50%. They assure positive engagement—with power-holding grip. Provide a degree of heat resistance and dissipation never before available. They give four times the durability for prolonging clutch life and extend the time between adjustments ten times as long. Let ROCKFORD clutch engineers show you how these new advantages will improve the operating ease and prolong the on-the-job life of *your* product.

SEND FOR THIS HANDY BULLETIN
Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

Small Spring Loaded

Automotive Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

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Power Take-Offs

Speed Reducers

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ROCKFORD Clutch Division BORG-WARNER
1307 Eighteenth Ave., Rockford, Ill., U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

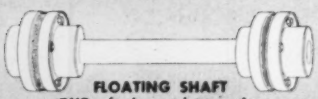
CLUTCHES

Specify
THOMAS
ALL METAL
FLEXIBLE COUPLINGS
FOR MAINTENANCE FREE POWER TRANSMISSION on PUMP, COMPRESSOR, MARINE and OTHER DRIVES

"TOMALOY" FLEXIBLE DISC RINGS

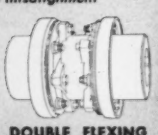
DBZ — for high speed, heavy duty drives

Thomas' 40 years of flexible coupling experience is at your disposal to help you meet ordinary applications or special variations for unusual cases.



FLOATING SHAFT
BMR — for heavy duty service with excessive misalignment

SINGLE FLEXING
SS — for engine-driven generator sets with out-board bearings



DOUBLE FLEXING
AMR — for engine and medium speed drives

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES.

1 Freedom from Backlash Torsional Rigidity
2 Free End Float
3 Smooth Continuous Drive with Constant Rotational Velocity
4 Visual Inspection While in Operation
5 Original Balance for Life
6 No Lubrication
7 No Wearing Parts
8 No Maintenance

Write for Engineering Catalog
THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U. S. A.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Heavy Steam Heating Coils

A catalog on heavy duty steam heating coils is available from Westinghouse Sturtevant Div. The 12-page booklet gives selection data and suggested piping arrangement, diagrams and description of the firm's extra-heavy wrought iron heating coil. —K–59

Mixers, Blenders

Read Standard Div. announces Bulletin No. 1483, which illustrates and explains its line of mixing and blending equipment for the chemical, plastics, pharmaceutical and paper industries.

Pilot plant mixers, batch and continuous ribbon blenders, continuous type mixers and unique split level design mixers are included. —K–60

Brass Valves, Fittings

A 20-page catalog giving size and application data for refrigeration and air conditioning brass valves, accessories and fittings, has been issued by Superior Valve and Fittings Co.

The bulletin, No. R-6, incorporates recent technical data on ASME approved relief valves, hermetically fused sight glasses and high capacity heat exchangers. —K–61

Pump Motors

Totally protected pump motors, from $^1/_8$ to 1000 hp, are discussed in a four-page, two-color bulletin, No. B-2507, issued by Reliance Electric and Engineering Co. The bulletin explains the firm's partial motor concept for attaching the machined motor frame directly to a pump frame to form an integrated unit. —K–62

Latch Relays

A new line of mechanically-held latched-in relays which need no extra vertical height is described in a bulletin available from the Clark Controller Co.

Bulletin 7305-PML describes the new Type PML latch relay, which lines up with the firm's standard Type PM relays with no increase in height, so that standard and latch relays can be located where desired on a panel without waste of space. —K–63

Pure Titanium Data

"Commercially Pure Titanium," an eight-page brochure describing the properties and corrosion resistance of pure titanium, has been published by Mallory-Sharon Metals Corp.

Typical chemical compositions and mechanical properties are tabled in the booklet. Various physical properties such as melting point, modulus of shear, electrical resistivity, magnetic permeability, coefficient of friction, thermal expansion, thermal conductivity are discussed. —K–64

VIGILANCE

The final victory over cancer will come from the research laboratory.

But there is a more immediate victory at hand today. Many cancers can be cured when detected early and treated promptly. *Vigilance* is the key to this victory.

There are certain signs which might mean cancer. Vigilance in heeding these danger signals could mean victory over cancer for you:

1. Unusual bleeding or discharge.
2. A lump or thickening in the breast or elsewhere.
3. A sore that does not heal.
4. Change in bowel or bladder habits.
5. Hoarseness or cough.
6. Indigestion or difficulty in swallowing.
7. Change in a wart or mole.

If your signal lasts longer than two weeks, go to your doctor to learn if it means cancer.

AMERICAN CANCER SOCIETY

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If you would enjoy receiving additional engineering information on any of the products

advertised in this issue or
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(Note: Students please write direct to manufacturer.)

When more than one advertisement appears on a page, the following code identifies the location of the ad on page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

MECHANICAL ENGINEERING—MAY 1958—Products Advertised

IFC	15	26, 27	46	155	169R	180L	190BR	201	215BL	231
1	16	28	47	156	171	181	191	202	215R	232
2	17	29	48	158	173	184L	192L	203	216T	IBC
4	18	30, 31	49	159	174L	185	192R	205	216BL	OBC
6	19	32	50	162	174R	186	193	206	216BR	
7	20,21	33-38	51	163	175R	187	194, 195	207	217TL	
8, 9	22	39	52	164	177	188	196	209	217TR	
10, 11	23	40, 41	53	165	178T	189	197	211	217B	
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Code number identifies location of item in Keep Informed Section—beginning page 157.

MECHANICAL ENGINEERING—MAY 1958—Keep Informed Section

K-1	K-12	K-23	K-34	K-45	K-56	K-67	K-78	K-89	K-100
K-2	K-13	K-24	K-35	K-46	K-57	K-68	K-79	K-90	K-101
K-3	K-14	K-25	K-36	K-47	K-58	K-69	K-80	K-91	
K-4	K-15	K-26	K-37	K-48	K-59	K-70	K-81	K-92	
K-5	K-16	K-27	K-38	K-49	K-60	K-71	K-82	K-93	
K-6	K-17	K-28	K-39	K-50	K-61	K-72	K-83	K-94	
K-7	K-18	K-29	K-40	K-51	K-62	K-73	K-84	K-95	
K-8	K-19	K-30	K-41	K-52	K-63	K-74	K-85	K-96	
K-9	K-20	K-31	K-42	K-53	K-64	K-75	K-86	K-97	
K-10	K-21	K-32	K-43	K-54	K-65	K-76	K-87	K-98	
K-11	K-22	K-33	K-44	K-55	K-66	K-77	K-88	K-99	

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Need more engineering information on products featured in this issue?

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. . . . . circle the page numbers of these advertisements or items . . . . . fill in your name and mail to us. Your requests will be promptly forwarded. All information will be directed to you.

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Core Analysis

Milton Roy Co. announces application engineering data sheet E-57-3 on maintaining constant pressures in core analysis. The sheet covers the application of firm's Constametric minipumps in core analysis.

In explaining the background and problems encountered in determining permeability and porosity data, the four-page bulletin describes how to maintain required pressures without pulsations with controlled volume pumps for accurate data evaluation of liquid-flow characteristics of low permeability rock samples. —K-65

Fan Cooling Towers

The firm's line of propeller fan cooling towers is described in a bulletin issued by Halstead & Mitchell. Belt drive, direct drive, and take-apart models in capacities of 2 to 125 tons are shown and described in Bulletin EC-500.

The bulletin gives rating data for proper selection under varying conditions. Detailed dimensions and diagrams are included, along with 12 installation suggestions that apply to all towers. —K-66

Complex Stainless Casting

How three new foundry methods are combined to produce a complex stainless steel casting is the subject of a 4-page bulletin available from Cooper Alloy Corp.

The casting, the main body of a fuel ignitor valve for a jet engine, is made of a high heat resistant tool steel and must be defect-free. Shell core, hot sleeve and CO_2 sand hardening, the three methods employed to solve the production problems, are described and illustrated. —K-67

Electromagnetic Controls

Condensed solenoid valve-electromagnetic control literature offered by the Automatic Switch Co., provides condensed information on the firm's product line.

Categories covered under solenoid valves include 2-way, 3-way, 4-way, corrosion resistant, manual reset, and special purpose valves. Electromagnetic control categories include automatic transfer switches, remote control switches, contactors, relays, solenoids, and electric plant controls. —K-68

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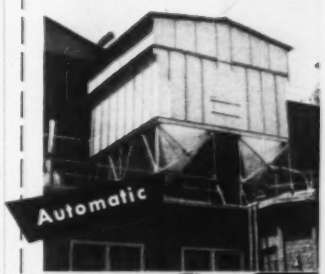
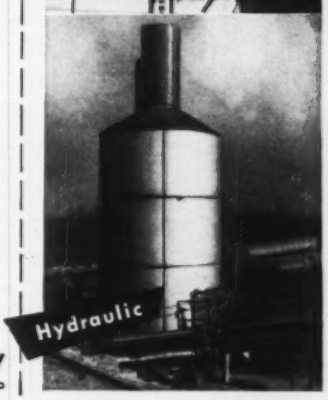
Consult Norblo

Guaranteed efficiency of fume and dust collection systems engineered and built by Norblo is obtainable because Norblo Equipment includes automatic bag type, improved centrifugal, and hydraulic types. Your operations may require one of these types — or all three! Norblo can tell you — will engineer the necessary combination to handle your dust and fume collection at most economical cost. More than 40 years experience serving many industries. State your problem so we can send literature on equipment applicable to your needs.





Replacement Bags

Dust Arrester bags do wear out eventually, and it's wise to replace them with the type best suited to your operation. Bags of various materials, made to our specifications, are available from the Norblo factory. Write for our Dust Arrester Bag Bulletin containing information on bag selection, hints for making successful bag repairs, and prices on five types of bags.

The Northern Blower Company
6421 Barberton Ave. • Cleveland 2, Ohio

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

NUGENT "Full-Flow" FILTERS in their 26th YEAR of service on Bush Terminal Locomotives

BUSH TERMINAL RAILROAD COMPANY
107 48TH STREET
BROOKLYN 32, N. Y.

December 13, 1957

William W. Nugent and Company, Inc.
3440 Cleveland Street
Skokie, Illinois

Attention: Mr. Corliss D. Nugent, President

It may be of interest to you and your Company that our seven Locomotives of this type have had continuous service since October 1932 and the majority of internal parts are still the original. I attribute this to your fine filter that is being used on these engines.

Yours very truly,

C. W. Jud
Master Mechanic

CWJ:ec

Mr. C.W. Jud, author of the statement above, is well qualified to judge the long term economy of Nugent *Full Flow* Filtering. Master mechanic for Bush Terminal Railroad Company, he was with that organization prior to 1932, when these seven Ingersoll-Rand diesel powered G.E. locomotives went into service. Mr. Jud reports that after more than 25 years of continuous service the majority of internal engine parts still require no replacement. This fact he attributes to the excellent performance of Nugent Lube Oil Filters, installed as original equipment on these engines.

If you have valuable equipment that demands dependable 'round-the-clock filtering protection with a minimum of maintenance, Nugent can help you. Send an outline of your requirements . . . we'll take it from there.

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.
3412 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

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Welding Torch Chart

Harris Calorific Co., has published a two-color welding torch chart. Illustrated are the appropriate welding and cutting tips and attachments to be used on its new No. 43 torch. Construction features of the torch, gas mixtures, and operation are described. —K-69

Carbon Steel Balls

Low-cost commercial-type carbon steel balls are described in Bulletin No. 102 released by Hoover Ball and Bearing Co.

Included in the bulletin are specifications, material analysis, guaranteed accuracy, case depth, weight and package information. —K-70

Processing Equipment

A brochure, No. 258, describing its field construction department, has been issued by Nooter Corp., fabricator and erector of processing equipment.

Processing industries covered in the brochure include chemical, petroleum, brewing, food, pharmaceutical, and public utilities. —K-71

Gear Generators

A 32-page bulletin on the company's gear generators has been published by Farrel-Birmingham Co.

It contains specifications, information on sizes and capacities and illustrations of machines in the T and C series. Included are descriptions of design features of these machines, said to give them the capability of generating gears of all types which operate on parallel axes. —K-72

Water Treatment Equipment

A 12-page bulletin, 4433, on treatment of municipal, industrial, and boiler-feed water is announced by Permutit Co.

The bulletin lists water impurities and methods of treatment, illustrates typical treatment systems and describes aerators, deaerators, precipitation equipment, filters, and ion exchange equipment. It tells how each piece operates and gives its advantages, limitations, range of flow rates. —K-73

Pre-Cured Tank Lining

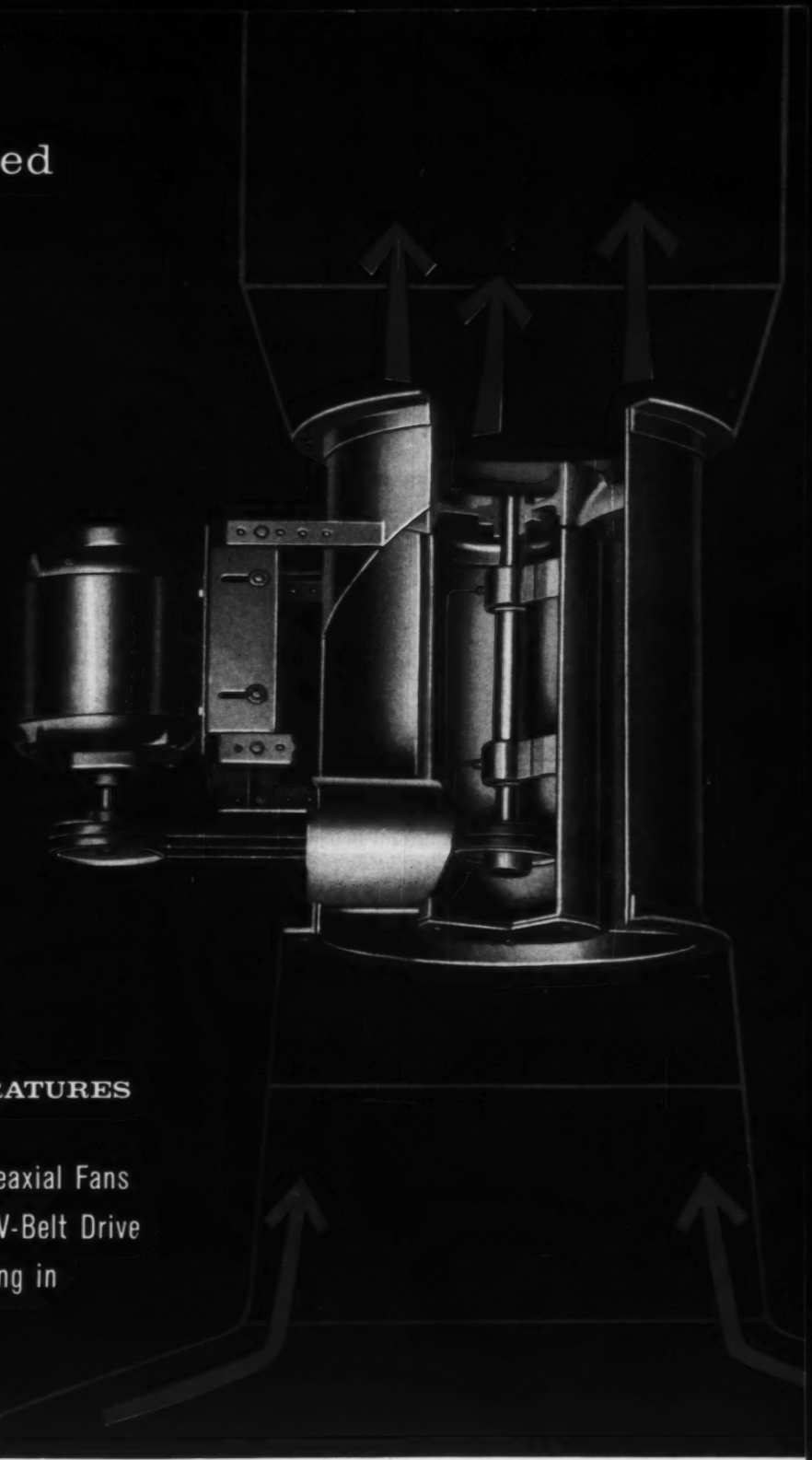
A technical bulletin describing properties of Fairprene T-5594 synthetic elastomer prevulcanized protective lining is available from Du Pont Fabrics Div., Room 8033, Du Pont Bldg., Wilmington 98, Del.

The illustrated, eight-page booklet sets forth in chart form chemical resistance results obtained from immersion tests. Data are also included on cements and putties used in fabricating liners from this unusual, pre-cured isobutylene material. —K-74

When you need

axial flow fans

for exhaust of fumes and vapors...



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STANDARD AIR
CORROSIVE GASES
ELEVATED TEMPERATURES

Specify Westinghouse Tubeaxial Fans complete with motor and V-Belt Drive ready for "in-line" mounting in duct or stack

Call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. E-3, Hyde Park, Boston, Massachusetts.

J-80641

YOU CAN BE SURE...IF IT'S

Westinghouse

Using stop motion, photographer Bernard Hoffman 'freezes' a tiny jet of water. Discharged at high pressure, the stream is a solid, unwavering mass.

Controlling Pressure in Fluid Engineering

Pressure is always a problem . . . either how much you need, or what you can do in spite of it. Accurate control requires the relation of other factors, like volume, time, and resistance. To get these answers, you can depend on the engineering leadership of S. Morgan Smith.

Take butterfly valves. Parts for a wide range of standard R-S Butterfly Valves, capable of satisfying most processing requirements, are carried in stock for fast assembly and shipment. These R-S Valves, with their streamlined vanes, give you minimum pressure drop, save pumping power. Regulation and closure are quick, and you get uniform flow control through all positions in the normal regulating range.

To obtain full information on the complete SMS line – R-S Butterfly Valves, Rotovalves or Ball Valves – call our nearest representative. Or, write S. Morgan Smith Co., York, Pa., for data on standard valves or special applications.

S. MORGAN SMITH SMS HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Diaphragm Seals

Diaphragm seals, designed to protect pressure instruments against corrosion and clogging, are described in Bulletin 250 available from Brooks Rotameter Co. **—K-75**

Temperature Controls

A folder, No. MC-157, issued by Fenwal Inc., describes the firm's Thermoswitch controls.

The four-page folder describes how the new unit can help equipment to run at fast speeds, require little maintenance, and have long life and low assembly costs. Also included are construction details of the control and six basic design configurations. **—K-76**

Combustion Gas Turbines

Versatility in application of the combustion gas turbine in the gas transmission, petrochemical, petroleum, chemical, rubber, and paper industries is described in a General Electric Co. publication, GED-3546.

Units covered range from 6700 to 30400 hp and from 4750 to 21800 kw in capacity. The data points out the availability of shaft power, exhaust heat, and hot air or gas which can be obtained from the combustion gas turbine operating on a number of fuels. **—K-77**

Steam Piston and Wet Vacuum Pumps

Duplex steam-driven liquid pumps are described in Bulletin 202-9 and wet vacuum pumps are described in Bulletin 221-9, issued by American-Marsh Pumps.

The piston-packed liquid pumps deliver a variable volume as needed at constant pressure for boiler feed or other fluid pumping operations. A choice of construction materials, ranging from bronze fitted to all iron or all bronze fittings, is offered. The wet vacuum pumps are designed for vacuum heating systems and manufacturing processes requiring vacuums to 26 in. Construction materials and performance and dimension data are listed. **—K-78**

Low-Voltage Switchgear

Major operating and maintenance innovations of its new K-line switchgear equipment are featured in a bulletin published by I-T-E Circuit Breaker Co.

The 20-page bulletin, No. 6004-C, provides a review of the company's low-voltage power circuit breakers and switchboards, ranging in unit ratings from 225 to 4000 amp. Innovations described for the new line of breakers include quick-make manual closure, pull-down handle actuation and simplification of trip unit continuous-current ratings. **—K-79**

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BUSINESS NOTES
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Milling, Grinding Machines

A machine tool catalog has been published and is now available from Brown & Sharpe Mfg. Co.

The 36-page illustrated catalog, designated as MT2, covers the company's entire line of milling, grinding and screw machines, and the various optional mechanisms and additional equipment available for them.

—K–80

Extruded Shapes

Revere Copper and Brass, Inc. announces a 44-page booklet on extruded shapes of copper, brass and other copper base alloys.

The booklet reviews design and cost advantages of extruded shapes, and substantiates these claims with 16 case histories reported in detail. Also included are a simplified drawing of the extrusion process, group drawings of extrudable shapes in profile, tables of comparative properties of copper-base alloys, material on how best to select these alloys and descriptive data on high conductivity copper bus channels and angles. —K–81

Adhesives, Coatings, Sealers

A four-page illustrated catalog describing ways that commercial trailer and mobile home production efficiency is increased with adhesives, coatings and sealers is available from Adhesives, Coatings and Sealers Div., Minnesota Mining & Mfg. Co.

Typical production applications of sealing lap seam joints, keeping insulation in place, bonding rubber to metal, protecting structural parts, deadening squeaks and noise with adhesives, coating and sealers. —K–82

Radiological Consulting

A bulletin describing the radiological health and safety consulting service of the Nuclear Div. Combustion Engineering, Inc., has been announced by the company.

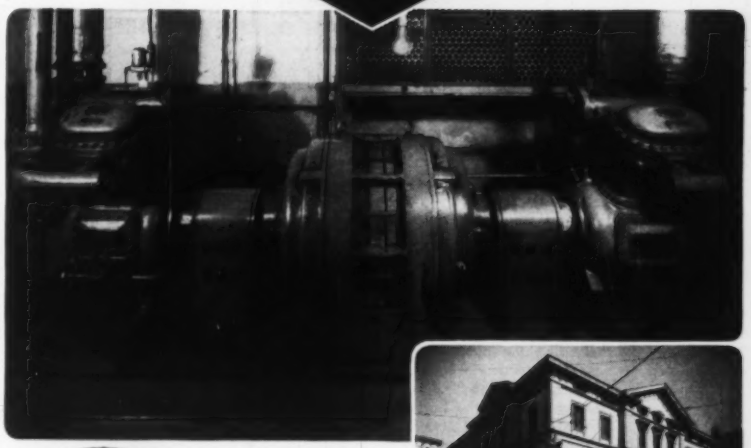
The service is intended to meet the needs of handlers and users of radioactive materials who do not have facilities or trained personnel to adequately monitor their operations, the firm states. —K–83

Centrifugal Compressors

Detailed engineering data; performance characteristics and a guide to writing specifications, are sections of a new centrifugal compressor catalog being offered by Clark Bros. Co.

The 64-page, illustrated catalog includes an introduction to centrifugal compressor features and applications; sections on horizontally and vertically split compressors; and a general section dealing with compressor fundamentals, parts, drivers, engineering data, and specifications. —K–84

17 YEARS



TVA OFFICES AT KNOXVILLE, TENN.

FRICK "ECLIPSE" COMPRESSORS

AIR CONDITION TVA OFFICES

TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENNESSEE

Frick Company
Waynesboro
Pennsylvania

Gentlemen:.

We have a Frick central air-conditioning system in our Old Post Office Building which was installed by your engineers in 1940. It consists of four compressors and two evaporative condensers.

As this equipment has been in continuous use throughout each year for seventeen years, we feel that it is time for a thorough check, and repairing or replacing of necessary parts.

To get a complete and competent check, and proper recommendations, we would like to have one of your staff engineers or field representatives examine our equipment and advise on necessary corrections; also to furnish any cost estimates.

If any of your factory personnel is planning on being in this area in the near future, we would appreciate their stopping here and making the inspection. In the event they do, would you advise us as to the date.

Very truly yours,
A. L. Boyd
Eastern District Manager
Office Service Branch

Frick equipment is world renowned for being better-built, more economical, and giving a lifetime of dependable service.

What are your COOLING needs? If you want cool air, cold water, ice, extremely low temperatures, or refrigeration for quick freezing and processing—in any commercial or industrial sizes—call in a Frick representative at the planning stage for recommendations and estimates. They have the specialized knowledge and equipment to solve your cooling problems.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U.S.A.

Type A centrifugal basic pump. Suction and discharge in lower half of casing.

45° A NEW SERIES

AURORA®

TYPE A

Two Stage Diagonally Split Case

MULTI-PURPOSE PUMPS 45°

Suited to BOILER FEED, Hot or Volatile Liquids duties etc., etc.

•

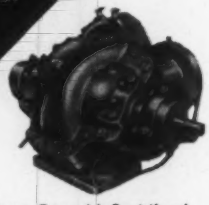
Low NPSH Characteristics

•

Being Self-Venting, Will NOT VAPOR LOCK

MANY BENEFITS

45° split case offers substantial new advantages while retaining all of the best features of the horizontally split case pumps—in that the entire rotating element can be removed without disturbing piping or disturbing the pump-motor-base alignment. 45° split allows both suction and discharge to be in the bottom half of casing but above the center line of the pump.



Aurora Type AJ Centrifugal Pump with Water Cooled Bearings and Stuffing Boxes

WRITE FOR BULLETIN 106DS

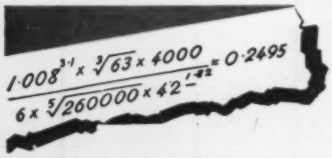
DISTRIBUTORS IN PRINCIPAL CITIES

AURORA PUMP DIVISION

THE NEW YORK AIR BRAKE COMPANY

96 LOUCKS STREET • AURORA • ILLINOIS

EXPORT DEPARTMENT — Aurora, Illinois — Cable Address "NYABINT"



A 66-inch Slide-rule for your pocket

Slide Rule Open

The GENIAC® Calculator carries 66-inch spiral scales yet measures only ten inches fully extended and six inches when closed. Four to five figure accuracy can be relied on. It is indispensable to the scientist, research worker and student. Administrative staff and business men will find it of tremendous value for a host of estimating and checking calculations.

The GENIAC® Slide Rule solves multiplication, division, percentage calculation and gives 5 place logarithms.

You may use it for 30 days and if you are not satisfied repack and mail it back.

What our users say:

"It does all you claim—four or five figure accuracy without eyestrain or magnifiers. Half an hour's study is ample for its use." A.E.B.

"I use the GENIAC Calculator for all my slide rule work and need the extra digit which normal slide rules cannot give. I had to get one of my customers a GENIAC Slide Rule last month, after using mine in his office." E. & G.H. Textile Manufacturers.

Slide Rule Closed

Send for yours now—Only $19.95 postpaid.

Oliver Garfield Co., Inc., Dept. ME-58

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FREE NEW Quick Reference CATALOG F-10R

OPW KAMLOK for hose and pipe

QUICK COUPLING ASSEMBLIES

Lots of illustrations clearly show the complete interchangeability of master gauged Kamloks. Detailed recommendations and sizing charts, typical specials for unique installations and factual information will help you in planning, selection and determining installation.

Just write us on your letterhead.

JORDAN CORPORATION

Industrial Sales Division OPW Corp.

6013 Wiehe Road, Cincinnati 13, Ohio EL 1-1352

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Coal-Fired Package Boilers

The Coal-Pak automatic series of bituminous coal-fired package boilers is described in a 10-page bulletin, 1100, released by International Boiler Wks. Co.

Available for low or high pressure hot water or steam systems, the boilers are supplied with combustion controls, automatic coal feed, and ash removal system for burning bituminous coal. —K-85

Lift Trucks

A cutaway brochure describing the firm's worksaver line of rider-walkie trucks has been published by Yale Materials Handling Div.

Using sectionalized views and a system of die-cut pages, the booklet pictorially disassembles the unit to point out all its operating features. The trucks are produced in pallet, platform, stacker, and tractor models. —K-86

Heat Transfer Products

An illustrated brochure describes the men, facilities, and products of American-Standard, Ross Heat Exchanger Div.

The publication shows how the firm puts primary emphasis on engineering in its exclusive role as a heat transfer specialist. Illustrations demonstrate a broad range of applications for equipment in practically every industry. Picture strips highlight modern engineering and fabricating facilities in the firm's newly-built plant devoted completely to large surface condensers and specially engineered exchangers. —K-87

Soot Control Systems

Bulletin 1029, published by Copes-Vulcan Div., Blaw-Knox Co., describes the company's line of automatic soot blowing control systems.

The 16-page bulletin gives engineering descriptions and illustrations of selective-sequence and automatic-sequential insert-type panel controllers. Physical dimensions and equipment specifications are included for each model, and a list of typical installations show a variety of applications. —K-88

Engine Testing System

A bulletin describing the S-100 automatic data handling and recording system for engine test facilities, has recently been released by BJ Electronics.

The system is designed to measure and record sequential information from various points during the test of jet and rocket engines, certain reciprocating engines and similar applications. The complete system comprises two major subsystems, measurement and data recording. Test variables of pressure, temperature and other inputs, represented by millivolt and frequency signals from the measurement subsystem; provisions for manual inputs, system control and data format presentation. —K-89

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Loading Dock Equipment

Rotary Lift Co. has issued a four-page catalog covering its new rotary automatic dock ramp.

Included are cutaway photographs and drawings to show action of the ramp. The booklet points out that the truck-actuated ramp has exclusive spring compensator in place of usual counterweight and is completely automatic. Models for recessed and front-of-dock installation. —K-90

Homogeneous U-Cups

Bulletin AD-163, published by Garlock Packing Co., details the firm's line of homogeneous U-cups.

The packings are molded of synthetic rubber and have flared side walls designed to create an interference fit especially suited to applications involving sudden pressure changes where instantaneous sealing is needed, or for low pressures. The bulletin describes uses, pressures, construction, available sizes and installation procedures. —K-91

Bronze Centrifugal Castings

A discussion of the advantages of centrifugal casting of bronze and copper parts for a wide range of applications is available from American Brake Shoe Co.

The booklet includes description of the technique, a chart showing all alloys available with their specific characteristics, illustrations of typical castings, NBD facilities and engineering services. —K-92

Polysulfide Liquid Polymer

A report of the results of current laboratory studies including the use of aluminum and carbonate-type fillers, additives for improved glass adhesion, toxicological effects and single package systems for calking and sealing compounds based on its polysulfide liquid polymers has been published by Thiokol Chemical Corp.

The aluminum filler evaluation covers 14 aluminum materials of which three are suggested for use in formulating aluminum-colored building sealants. The results shown indicate that five of six calcium carbonate-type materials tested can be used as fillers to obtain low-cost, light-colored sealing compounds. In addition, the data included shows the feasibility of single-package compounds obtained by low temperature storage. Also listed are additives available for improving the adhesion of sealants to glass, and agents for masking the odor of polysulfide liquid polymer compounds. —K-93

Unit Heaters

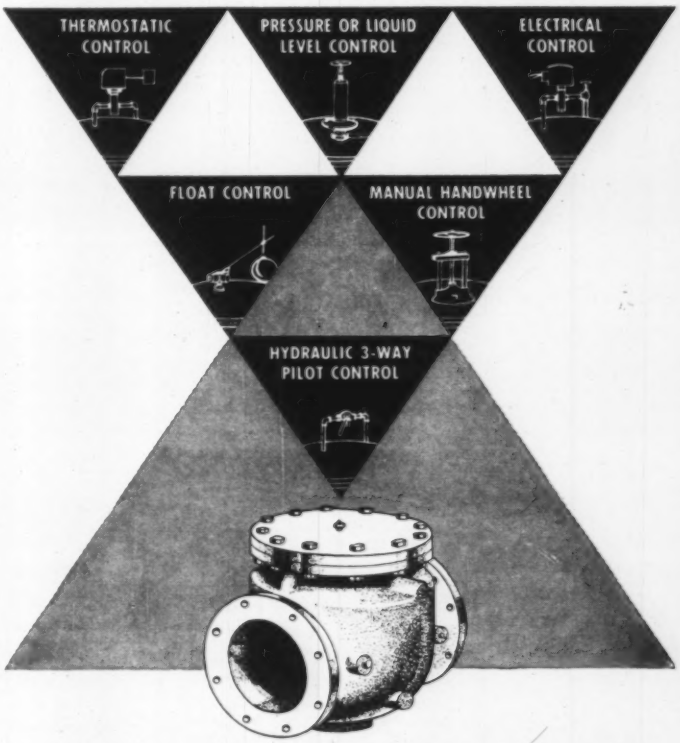
A booklet on unit heaters is available from Westinghouse Sturtevant Div. Containing illustrations and tables, the 26-page booklet describes construction and application of a new line of commercial and industrial unit heaters. —K-94

Proportioning Pumps

A two-color, eight-page catalog, No. 604, featuring precision proportioning pumps has been released by Hills-McCanna Co.

The catalog covers details and specifications of pumps with maximum capacities ranging from 6 cc/min to 730 gph per feed. —K-95

Select the CONTROL you want for Automatic Valve Operation . . .



***with the G-A Cushioned* FLOWTROL VALVE**

• Operates automatically with any fluid, any control • Angle or globe body, bronze or non-corrosive liner • Air and fluid cushioning prevent hammer in closing • Available sizes 2" to 36" for pressures to 250 psi

GOLDEN ANDERSON Valve Specialty Company
1223 RIDGE AVENUE, PITTSBURGH 33, PA.

Write for Bulletin W-8A

Designers and Manufacturers of VALVES FOR AUTOMATION

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Bucket Elevators

A bulletin describing the Rex-rated standard industrial bucket elevator line has been released by Chain Belt Co.

The new brochure includes simplified selection data and describes the firm's balanced design of the elevators whereby chain, sprockets, take-ups, bearings, buckets, and pulleys are mated or matched for their rated capacity. —K-96

Nonlubricated Compressors

A new line of nonlubricated compressors is being built by Ingersoll-Rand Co. for heavy-duty service where the air or gas being compressed cannot be allowed to contact oil or other lubricants. The units are described in the manufacturer's new flier, Form 3251.

The new ESH-NL compressors have special compressor cylinders which are said to require no oil or other lubricants, due to use of self-lubricating materials in pistons and packing, as well as the firm's NL channel valves. They use the same frame and running gear as the company's new ESH horizontal compressor, and are also available as vertical units (called ESV). —K-97

Drafting Templates

Rapidesign, Inc., announces the availability of a new template catalog, No. 60.

The catalog carries photographs and description of the 91 templates now being made by the company. An index for the first time lists templates by number and by category. The catalog is divided into seven sections: electrical, ellipses, mechanical, general, architectural, processing. —K-98

Oscillographic Recording

A 16-page catalog contains descriptions, specifications, and prices of "150" oscillographic recording systems and the line of "150" accessories and unit instruments offered by Sanborn Co., Industrial Div.

Equipment described includes 1-, 2-, 4-, 6-, and 8-channel systems; 11 interchangeable, plug-in preamplifiers used in these systems; model 150-3100 Triplexer; portable "150" systems; and systems for analog computer readout, including the 2- to 8-channel "150" style and the new, compact 6- and 8-channel mobile consoles. Unit instruments and accessories are also described. —K-99

Coke Quenching Valves

Coke quenching valves, manufactured by Golden-Anderson Valve Specialty Co. are fully described in technical bulletin W-15.

Installation arrangements, parts lists, and dimensions are included for both the coke quenching valves and drain valves. —K-100

Panel Fastener

Two technical bulletins containing engineering specifications and qualification test data for the QAF quick-action stressed panel fastener have been issued by Waldes Kohinoor, Inc.

A three-page illustrated brochure contains a description of the fastener, which is designed for use on structural load-carrying panels in aircraft, guided missiles, and other applications where quick access to service areas is required.

A nine-page illustrated bulletin is devoted to the results of a series of qualification tests conducted in accordance with the specifications of, and as supplements to, National Aircraft Standard (NAS) 547, Revision No. 1, dated Oct. 15, 1956. —K-101

The ADDED Ingredient... Know-How—
...HAS MADE
DUDEK & BOCK
THE Leader!
WIRE FORMS
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METAL STAMPINGS
In Industry, in homes, farms and shops, you'll find daily, living proof that D-&-B's KNOW-HOW pays out in EXTRA performance. Rely on expert engineers for parts that meet your exact needs and save you MONEY! Get Wire Forms, Springs and Stampings that are easily assembled . . . that withstand stress . . . and perform under the most trying conditions!
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SPOT VIBRATION WEAK SPOTS BEFORE COSTLY FAILURE!
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Horizontal Vibration, 5-100 C.P.S.
• How much vibration will your product take? Where are the danger areas? All American Vibration Fatigue Testers answer these questions in your shop or laboratory with shake-down tests that simulate field service vibrations. Engineering gets the facts needed to improve design at lowest cost. Equally effective in spot-checking production runs.
• All American Testers meet U.S. Government specifications for horizontal or vertical vibration testing of all sizes and shapes of units weighing up to 150 lbs. Range Selector automatically controls acceleration and deceleration, or holds vibration frequency at any desired point between 5 and 100 cycles per second.
CATALOG "F"
gives full facts on all 10 All American Testers, proved in long service to government and industry.
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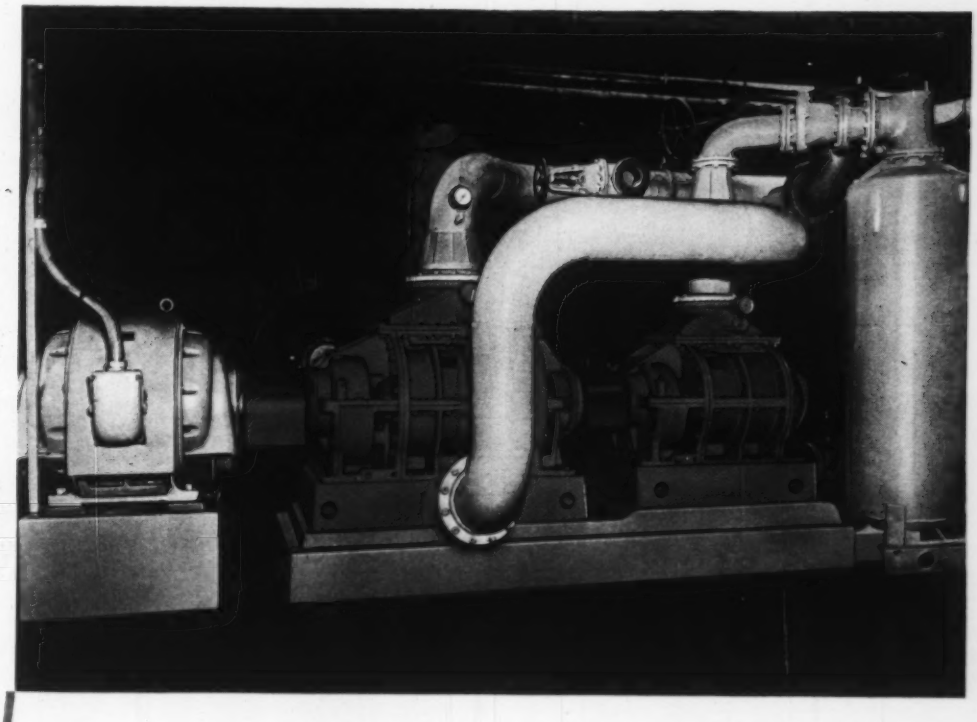
FOR CHEMICAL AND ORE PROCESSING



RCV-2 vacuum pump — 16x35 and 14x24 in compound arrangement, rated 7740 cfm at 22" Hg vacuum, operating at 900 RPM with 294 HP.

NEW R-C compound vacuum pump arrangement simplifies installation

With a new "straight-through" drive design for compound vacuum pump applications, Roots-Connersville has not only simplified piping arrangements but has also further reduced installation time and costs. This new development features a drive-through arrangement with the second stage pump driven directly from a shaft extension on the first stage pump. This permits the use of a standard single shaft extension motor drive. Other pump improvements provide for operation at higher speeds giving more CFM per dollar.

In addition to simplifying installation of the piping, this arrangement provides for easier servicing and maintenance of both pumps and motor. Installations of this new arrangement in chemical plants, uranium and taconite processing plants and paper mills have completely substantiated its advantages in long, uninterrupted performance.

Here is another reason why you can depend on Roots-Connersville equipment for vacuum service to deliver the finest overall performance and dependability at low cost . . . a reputation proved for generations in the country's leading industries.

For additional data, please refer to our section in Chemical Engineering Catalog or write for Bulletin VP-158

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

558 Michigan Avenue, Connersville, Indiana. In Canada 629 Adelaide St., W., Toronto, Ont.

Wear Resistance is a common problem for designers, even when they're using a durable material like steel. Of course, it is well known that you can increase the abrasion resistance of a given steel when you improve its hardness (and thus, its strength). But when you harden and strengthen a steel so that it will resist wear, you usually run into some complications.

For instance, when we vary the wear resistance of steel, we also vary its *other* properties, and this causes problems for the designer or his metallurgical advisor. Examples: hardness and strength can be developed in various ways—increase the carbon content, add alloying elements, cold work, heat treat. These methods vary in cost, and each has a different effect on hardness, strength, toughness, corrosion resistance, formability and weldability.

There is one steel with the best combination of properties for every design application, and you're almost sure to find it in the vast range of USS Design Steels—whether Carbon, High Strength, Alloy or Stainless Steel. Here is the widest range of steels available, offered by a company that has produced well over a *billion* tons of steel.

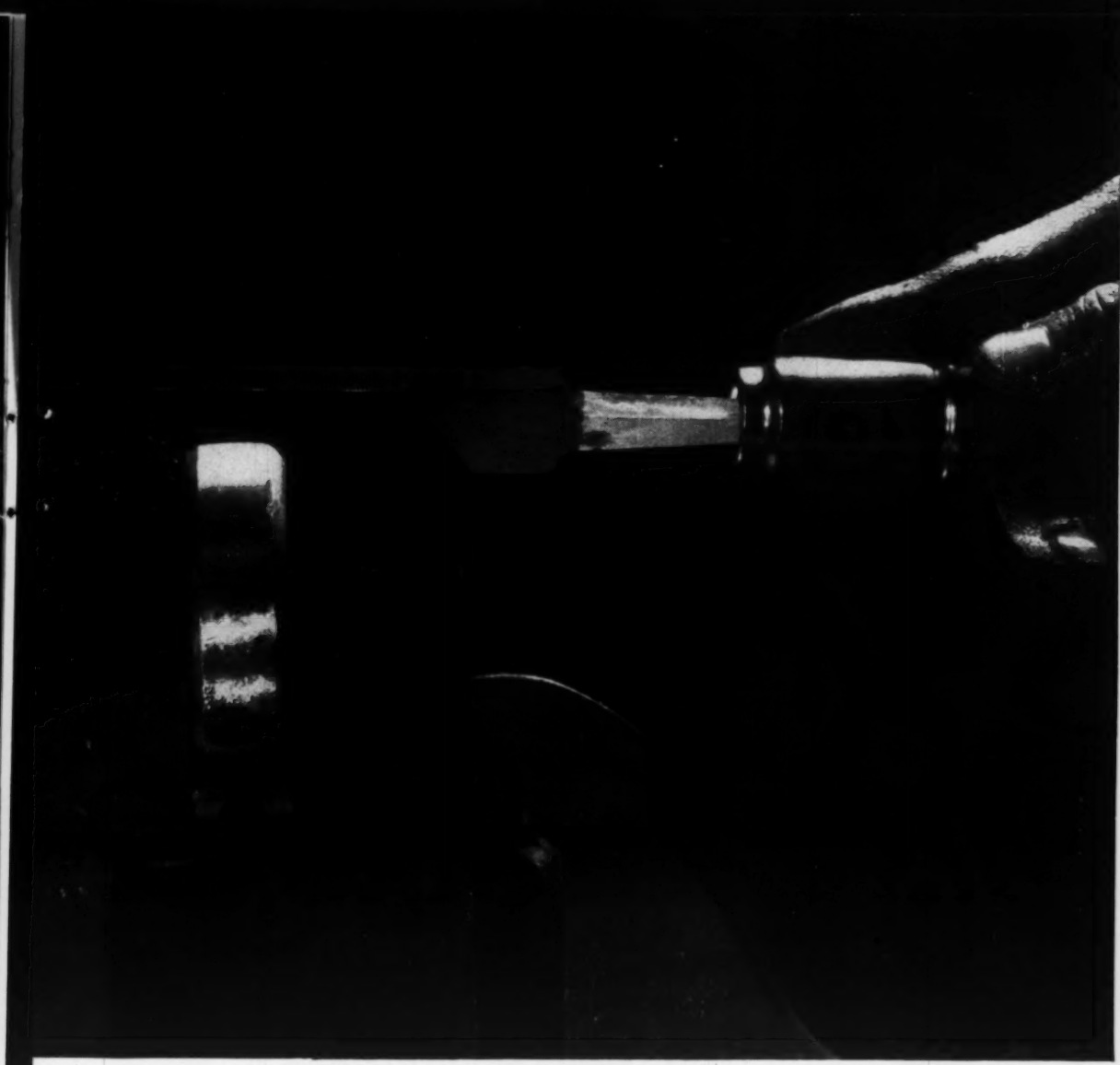
Of course, over-design must be avoided as rigorously as under-design, and designers must always walk the prickly path between poor product performance on one hand and high costs on the other. Somewhere among the many USS Design Steels there is the one best steel for the job. The final selection can best be made with the help of a skilled metallurgist—either on your staff or ours.

United States Steel Corporation • American Steel & Wire • Columbia-Geneva Steel • National Tube
Tennessee Coal & Iron • United States Steel Supply • United States Steel Export Company

USS TRADEMARK

United States Steel

STEELS FOR DESIGN

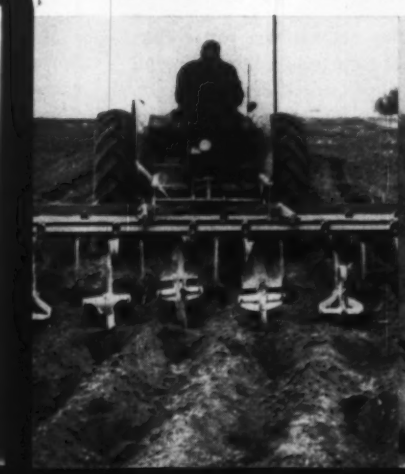


Lower Left—Problem: Blades on this earth dammer wore out after 300 acres. Solution: Blades are now made from USS MAN-TEN Steel, one of several USS HIGH STRENGTH STEELS. Benefit: Blades now last over 1,000 acres for Gunning Mfg. Co., Lansford, N. D.

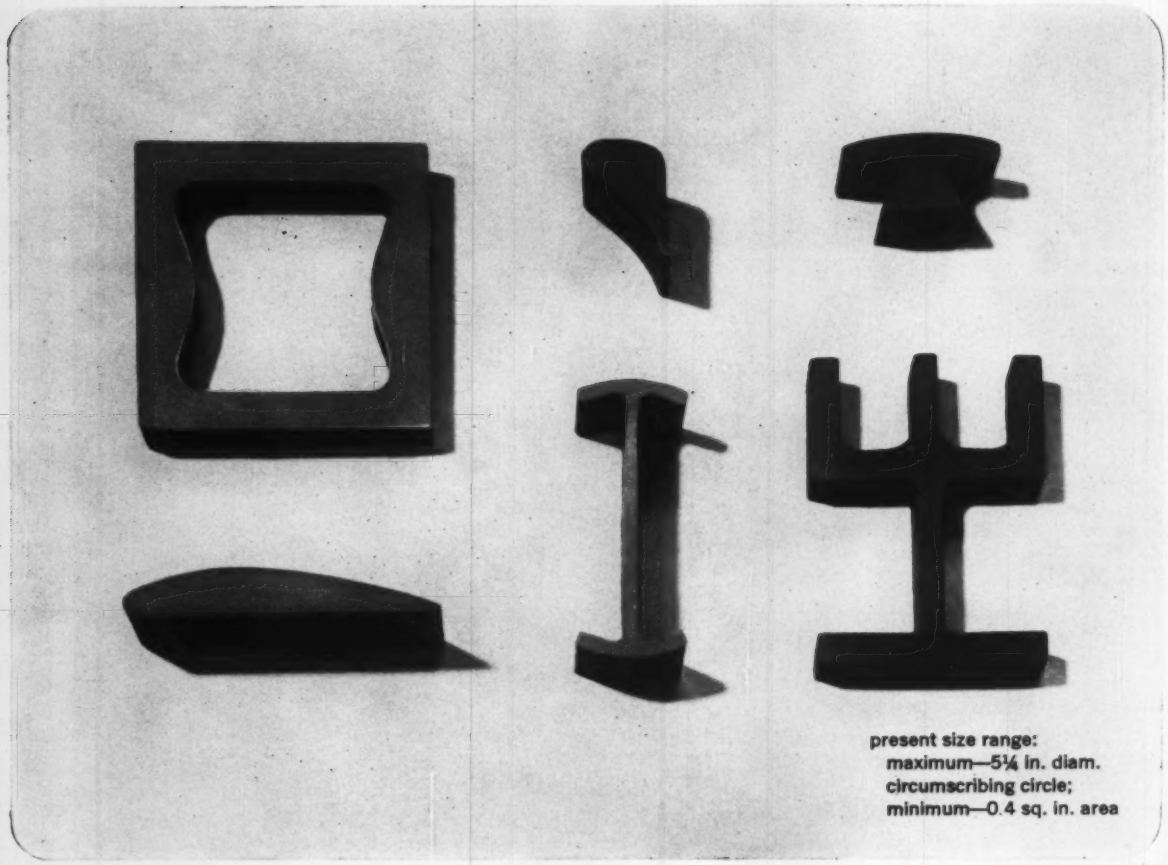
Lower Middle—Problem. The new "Snow Hawg" rotary snow plow chews into ice, rock and frozen earth and throws it up to 300 feet. A weldable, very strong steel was needed to withstand the punishment. Solution: Vital parts are made from USS "T-1" Constructional Alloy Steel. It can be field-welded, and remains strong and tough down to minus 50°F. Benefit: Outstanding performance, and chute liners of the "Snow Hawg" last two to three times longer.

Lower Right—Problem: Chutes in a coal processing plant wore out prematurely due to abrasive action of coal and corrosion from acid water. Solution: Chutes made from USS Stainless Steel were installed. Benefit: New chutes outlast old ones seven to one. Atkins Coal Company, Frackville, Pa., estimates that a $900 investment in Stainless Steel chutes saved $30,000.

USS, MAN-TEN and "T-1" are registered trademarks of United States Steel



Experience—*the added alloy in* ***A-L Stainless, Electrical and Tool Steels***



- 321 Stainless
- 410 Stainless
- 405 Stainless
- SAE 1020
- 304 Stainless
- SAE 4340

Here's how highly intricate steel extrusions from Allegheny Ludlum help you cut costs

Allegheny Ludlum Extrusions can help you cut costs, save money. If you are now rolling, casting or machining steel parts like these, consider the cost-cutting features inherent in extruding metal, already proved by non-ferrous extrusions during the last 10 years.

A-L high-quality Steel Extrusions can save you money on four very important counts. (1) Orders are taken in quantities as small as 40 pounds. No large tonnage rolling requirements. (2) Charge for die design is low—under $200. No expensive rolls to cut. (3) Machining costs are slashed to a minimum; there's no waste of material. (4) Extruding saves time from the order to availability of finished parts.

There is no limit to what steels can be extruded. Allegheny Ludlum works everything from all stainless grades to carbon and electrical steels, high temperature alloys, nickel alloys and even metals such as zirconium.

Prove to yourself that extruding steel can save you money. Write for Allegheny Ludlum's 12-page technical bulletin, full of process explanations, material properties, design tips, etc. Or contact your nearest A-L office for technical assistance.

Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pennsylvania. Address Dept. ME-5.

WSW 7130

ALLEGHENY LUDLUM

for warehouse delivery of Allegheny Stainless, call RYERSON

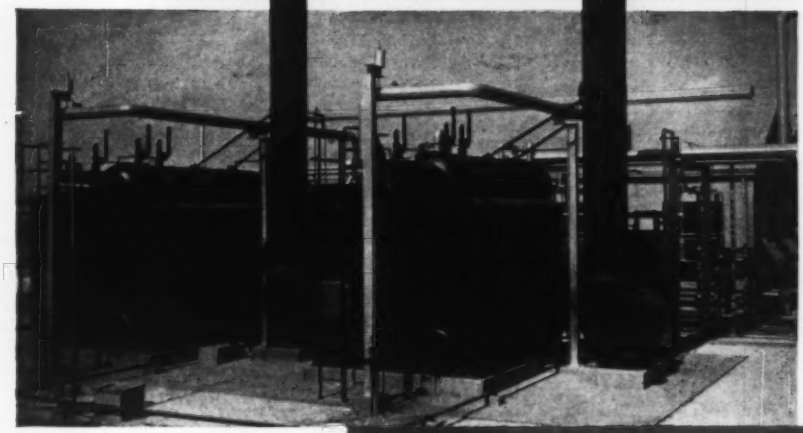
Export distribution: AIRCO INTERNATIONAL

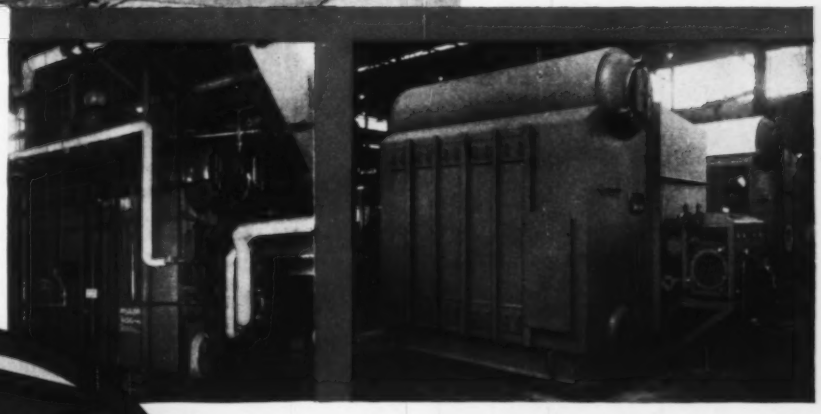
EVERY FORM OF STAINLESS . . . EVERY HELP IN USING IT

Vogt

Package

STEAM BOILERS *give* versatility with economy





Above: Two units serve a gas pipeline company.

Left: Installation in fibre box-board plant.

Right: Unit for a leading soap manufacturer.

Enroute to an office building.

FOR POWER, PROCESS OR HEATING

Available in capacities from 10,000 to 50,000 pounds steam per hour in three standard pressures of 175, 250 and 375 pounds per square inch gage, factory assembled.

Write for Bulletin PSG-2, 24A-BM

HENRY VOGT MACHINE COMPANY, Louisville, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati.

OTHER VOGT PRODUCTS:

DROP FORGED STEEL VALVES, FITTINGS, FLANGES AND UNIONS
PETROLEUM REFINERY AND CHEMICAL PLANT EQUIPMENT
HEAT EXCHANGERS • ICE MAKING & REFRIGERATING EQUIPMENT

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STUDENT MEMBERS...
ADVANCE
YOUR FUTURE
IN

ENGINEERING

WIN EXPENSE PAID TRIPS TO

DETROIT AND NEW YORK

PLUS CASH AWARDS IN 1958

1 CHARLES T. MAIN AWARD

$150 cash prize and trip to New York for the best paper on the subject of "Student Development of Professional Engineering Attitudes and Ethics."

2 OLD GUARD PRIZE

$150 cash award and trips to Detroit and New York

3 UNDERGRADUATE STUDENT AWARD

$25 cash prize plus trip to New York for best paper on an Engineering subject.

4 POSTGRADUATE STUDENT AWARD

$25 cash prize plus trip to New York for best paper on an engineering subject

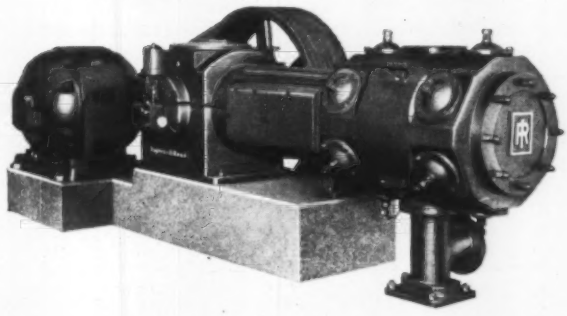
for rules covering eligibility, preparation and closing dates for these awards

CONSULT YOUR FACULTY ADVISER NOW!

NEW COMPRESSORS

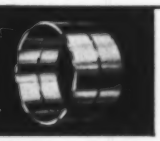
...with heavy-duty features proven in larger Ingersoll-Rand compressors

ESH* (horizontal)



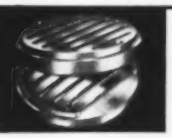
ESV* (vertical)

*The same compressor in either horizontal or vertical arrangement – 20 to 150 hp sizes, single-and multi-stage, pressures up to 5000 psi and vacuums.



Full-floating aluminum bearings never need adjustment

The full-floating bearings "roll with the punch," taking each thrust on a different portion of the shell. They are foolproof, and never require fitting or adjustment. Main and crankpin bearings are made of I-R's special aluminum bearing alloy, which has higher load capacity and better heat conductivity than other bearing materials.



Air-cushioned Channel Valves give unmatched performance

Known the world over for lasting efficiency, dependability and quiet operation, Ingersoll-Rand air-cushioned Type A Channel Valves are entirely different in design and principle from any other valves in use. Type A Channel Valves were developed especially for modern compressor speeds, and feature a separate stainless-steel seat plate which can be reversed or replaced for new life.

Never a need for adjustments– frame is kept sealed!

Here's an entirely new line of compressors, built to run longer — much longer. They're more compact, more efficient, and require less attendance, less maintenance. They offer greater capacity in less space, and are ruggedly built and highly refined to take years of continuous hard service.

All running parts are precision-machined and need no fitting or adjusting, so the frame is sealed — dirt stays out, and the major causes of wear are eliminated!

There are many design features—including filtered force-feed lubrication and full-floating self-adjusting metallic packing — that have heretofore been found only in larger Ingersoll-Rand compressors. Let your I-R representative tell you more about these new compressors, and how they can save you money.

Ingersoll-Rand

I-815 11 Broadway, New York 4, N.Y.

In engineered products, there's no substitute for experience!

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

TO KEEP REJECTS TO A MINIMUM AT RCA VICTOR RECORD DIVISION

Pumps must maintain pressures accurately ...24 hours a day...5½ days a week

Here's the problem. Millions of records per month pour from a battery of hydraulic molding presses in RCA Victor's Rockaway, N. J., Record Division plant. The entire operation is highly dependent upon the pumps in the central hydraulic system. If there is pressure variation, record mold cavities don't fill. Reject rates go up fast. If pumps fail . . . presses shut down. Either way, critical delivery schedules become so much scrap paper . . . RCA's reputation for fast dependable service suffers.

How RCA Solved the Problem. Five Aldrich-Groff variable stroke "Powr-Savr" pumps supply hydraulic pressure for the molding pres. s. They provide stepless, straight-line capacity control from zero to rated output. Automatic adjustment maintains pressures accurately and indefinitely at 1800 psi. Molds fill properly, rejects are minimized. Another plus: pumps handle water as a hydraulic medium . . . completely eliminating fire hazard.

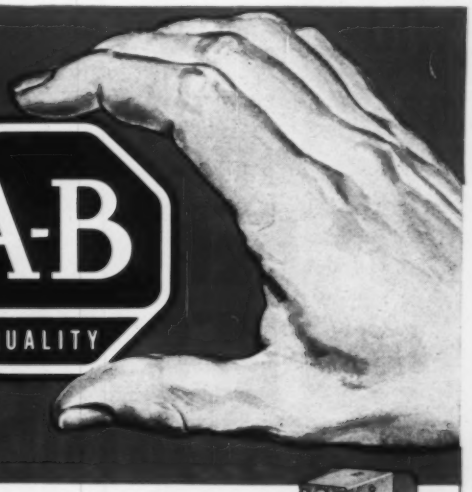
Results: Excellent, right from the start. Four Aldrich-Groff pumps were installed between 1947 and 1950. In 1954 they were moved to the new Rockaway plant, and in 1956 another was installed. Pump dependability has been perfect . . . only routine maintenance.

Yet they have operated "round-the-clock", 5½ days a week since installation. Mr. F. G. Stubbs, Plant Engineer, has this to say, "These Aldrich Pumps do a wonderful job". Want more information? Write Aldrich Pump Company, 29 Pine Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

AMONG PRODUCTION ENGINEERS... ALLEN-BRADLEY IS THE PREFERRED CONTROL!

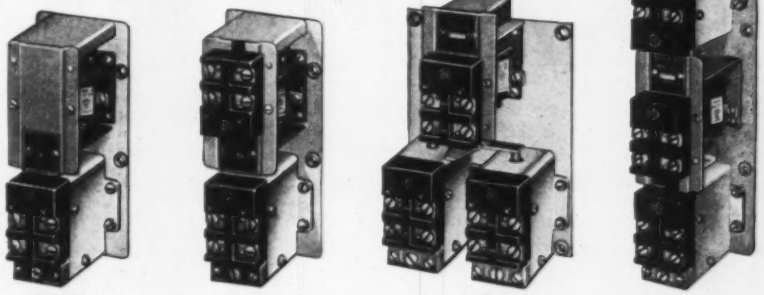
THE "SIGN" OF
trouble free
TIMING RELAYS!



Pneumatic Timing Relays

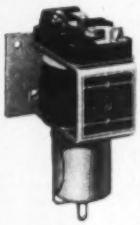
BULLETIN 849

These versatile timing relays are available in a variety of types for either "on delay" or "off delay." Delay time is adjustable from 1/20 to 180 seconds with an accuracy of ± 10%. Maintenance free silver alloy contacts. Additional auxiliary contacts easily added. A.C. or D.C. operation.



STANDARD UNIT | AUXILIARY CONTACTS ADDED | TWO TIMING UNITS | COMBINED ON-OFF TIMER

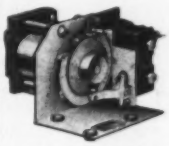
Fluid Dashpot Timing Relays



BULLETIN 848

For applications where reliability is more important than accuracy. As the viscosity of the silicone fluid does not vary with temperature, the timer's accuracy is ± 15% from −30°F to + 120°F. Can be easily adjusted from 2 to 30 seconds.

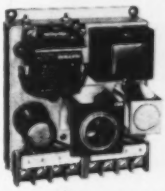
Motor Driven Timing Relays



BULLETIN 850

Driven by a Telechron motor, this timer alternately opens and closes two switch units. Made to provide 2, 3, 4, or 6 operations per minute on 60 cycles. Running and drift time on both contact units are easily adjustable.

Electronic Timing Relays



BULLETIN 852

An accurate and flexible A.C. timer, designed for frequent operation. Can be recycled rapidly over long periods. Time delay is dial adjustable over a range of 20 to 1. Repetitive accuracy ± 2%. Eight units provide time delay of 0.025 to 120 seconds.

This broad line of timing relays carries the traditional Allen-Bradley trademark of *quality* that stands for trouble free operation. The rugged construction and maintenance free, silver alloy contacts have made them first choice among men in the field... engineers, consultants, and contractors. You just cannot go wrong when *you* specify Allen-Bradley control... by name!

Send for your copy of the new 7th Edition of the Allen-Bradley Handy Catalog... it's an encyclopedia of motor control information.

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

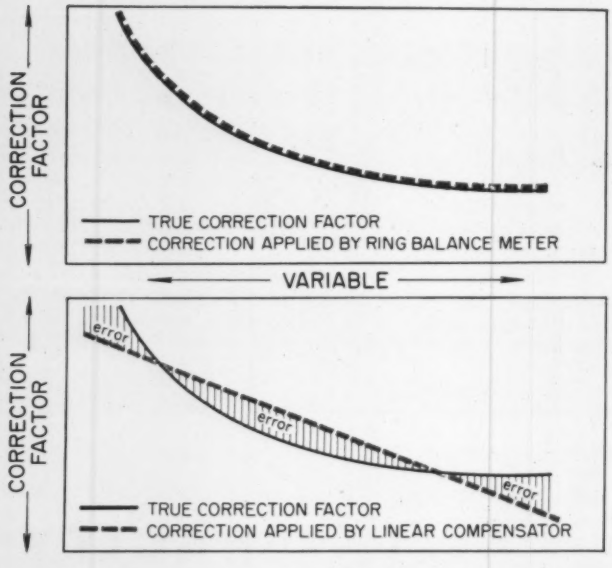
Allen-Bradley Co., 1308 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

HAGAN RING BALANCE FEATURES—NO. 5

wide range AUTOMATIC COMPENSATION for PRESSURE-TEMPERATURE variations

In any metering application where true level or flow cannot be inferred from differential alone, because of variations in fluid density, the Hagan Ring Balance meter can be compensated for these variations.

A simple, integral linkage computes the correction factor from temperature, pressure, density or a combination of these and applies the correction automatically. The accuracy of this correction is maintained over a wide operating range by the geometry of the linkage.



Wide range compensation is made possible in the Hagan Ring Balance meter by the unique curvilinear motion generator. The compensation applied is correct throughout its entire range because it is characterized to fit the true correction curve at all points—see top diagram.

Other methods of compensation, which utilize straight-line correction, conform to the true correction curve at only two points, producing error in the compensation as shown in the bottom diagram.

The Ring Balance compensated meter gives all the information necessary for a quick, visual check of the computation it is performing. Both the corrected and uncorrected values as well as all variables are displayed either as records or indications.

With fifteen years of pioneering in the practical application of precise metering, such difficult measurements as drum level in high pressure boilers, pre-heated air flow, delivery of blowers and exhausters, and extraction steam flow, Hagan engineers have the experience and background to help you solve either routine or unusual metering problems.

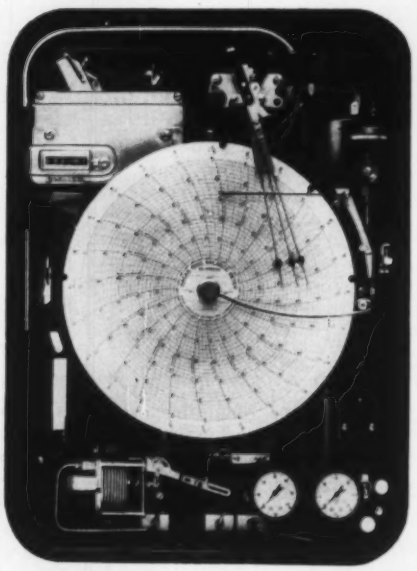
Ask your Hagan engineer to explain these other Ring Balance features:

1. Ease of calibration under operating static pressures with factory calibrated check weights! No more four-story water columns and telephones!
2. Safe operation with rings rated at 2,500, 6,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eye-droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5″ w.c. to 560″ w.c. Adjustment on any one ring over a 7:1 differential range.
5. High sensitivity at low flows due to unique range calibration system.
6. Pneumatic or electric transmission also available. Any Ring Balance meter can be equipped with slide-wire for operation with data-logging devices and for transmission to the Hagan PowrLog.

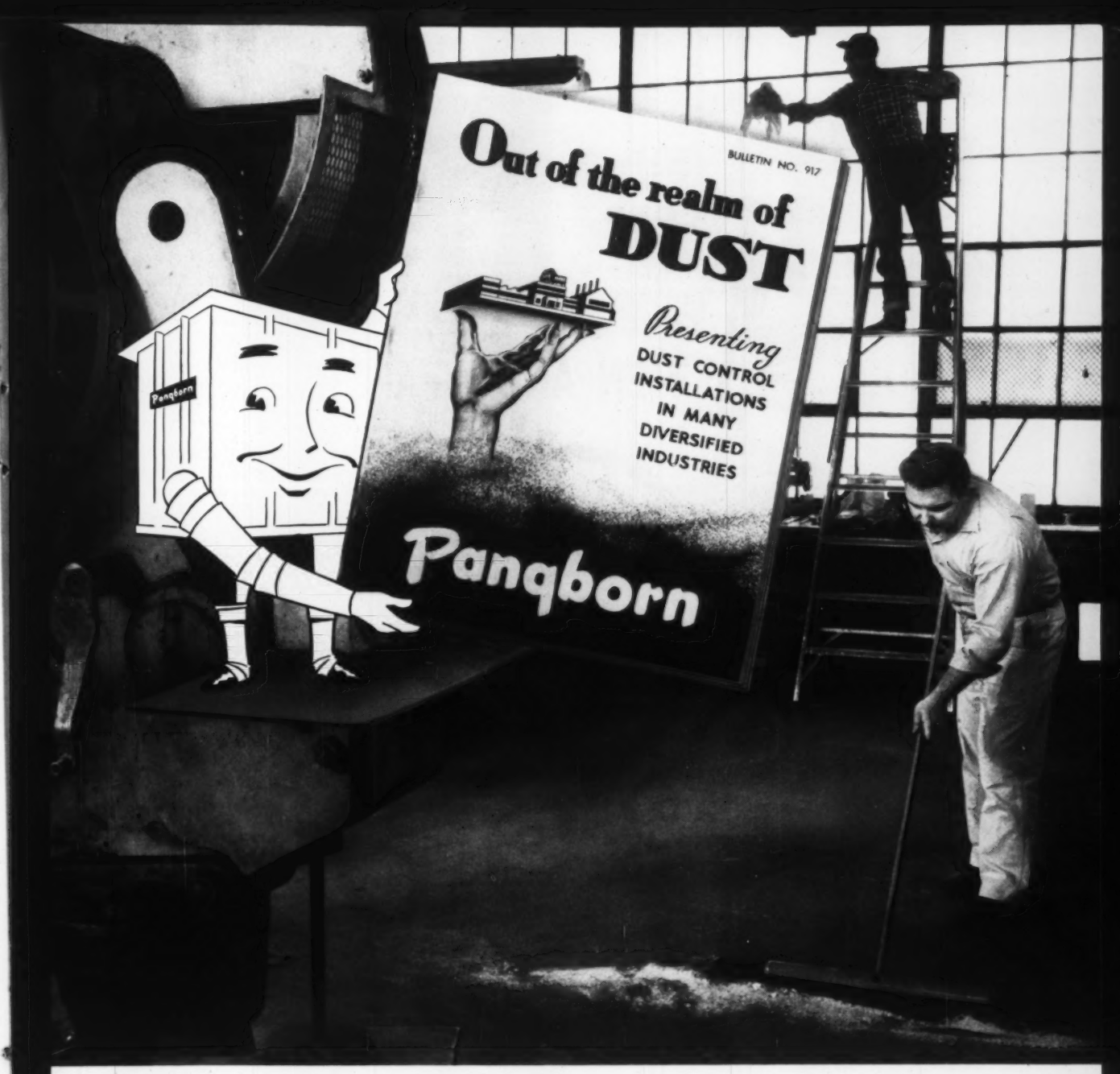
For additional information, write for Bulletin MSP 147.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO



Compensated Hagan Ring Balance meter with door removed. The three pens record uncorrected flow, corrected flow and pressure. Corrected flow can be integrated and transmitted for remote recording or control purposes.



Lower housekeeping costs? Pangborn Dust Control! Here's why!

Yes, this fascinating booklet *tells* you why. It tells you what Pangborn Dust Collectors have done for many different companies in many different fields. How they have cut plant housekeeping costs for these firms . . . lengthened machinery life, improved employee efficiency and morale, reclaimed material for salvage. How Pangborn can give *you* these benefits.

Why Pangborn Dust Control? Because Pangborn offers the most efficient methods of dust collection on the market. Pangborn has spent 50 years dealing with dust problems . . . experience that is incorporated in every proposal. And Pangborn's extensive line of wet and dry collectors means that one of these units can be adapted with maximum effectiveness to *any* problem.

Send for your *copy of "Out of the Realm of Dust." And remember: the Pangborn Engineer in your area will be glad to take off his jacket and go to work on your dust problem at no obligation.* PANGBORN CORP., *2200 Pangborn Blvd., Hagerstown, Md. Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS **DUST**

ABOUT MEN AND WEAPONS

For centuries men have tried to develop new and more powerful weapons to achieve victory in war.

Lately these have been weapons of unprecedented power.

Now war can become race suicide, and victory thus gained is a delusion.

Yet we keep on trying to develop new and more powerful weapons, because we must.

Not because we seek victory through a nuclear war, but because through strength we may prevent one.

For as long as there are powerful forces with a record of cynical duplicity and oppression, the free world must have weapons capable of neutralizing them.

At least until men learn that the only alternate to peace is oblivion.

At Sandia, we play an important part in providing this protective strength. Our scientists and engineers are responsible for research, design, and development of nuclear weapons for the Atomic Energy Commission. This makes these men exceptionally valuable assets in our nation's efforts to secure the future.

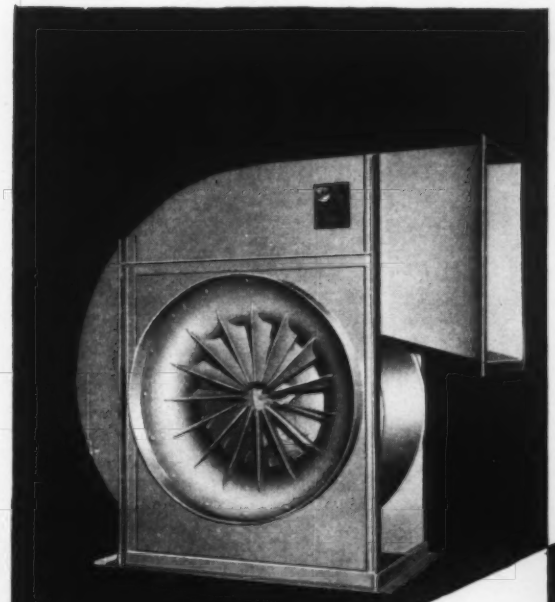
We need more such men — outstanding engineers and scientists in many fields, especially at the highest academic and experience levels. At Sandia in Albuquerque and at our branch laboratory in Livermore, California, we need their knowledge, skill, and perseverance.

If you can help us meet this need, or if you know anyone who can, write Staff Employment Section 553.

SANDIA CORPORATION

ALBUQUERQUE. NEW MEXICO

MINIMUM MAINTENANCE, LONG LIFE ASSURED BY THESE HEAVY-DUTY "BUFFALO" FANS



"Buffalo" Type "BLH" Fan
For Classes III & IV Service

"Buffalo" Type "BL" Fan
For Classes I & II Service

The high performance characteristics of these two outstanding "Buffalo" Fans has resulted in their widespread use in the field of industrial air handling. In addition to offering peak-efficiency operation in their respective classes, both the "BL" and the "BLH" bring you a bonus economy factor of *maintenance reduced to an absolute minimum* throughout a long, productive life. This minimum maintenance factor is directly due to unusually rugged "Buffalo" construction features such as:

HOUSINGS — The heavy gauge sides and scroll are of all-welded construction. Heavy structural steel bracing provides housing stiffness and rigid bearing support. Flanged inlets and outlets give added support.

SHAFTS — Hot-rolled or forged shafts are ground to close tolerances for perfect wheel and bearing fit.

WHEELS — Sturdy backward-curved blades are welded to the die-formed shroud and welded or riveted to the solid backplate. Heavy hubs assure permanent shaft alignment. For higher tip speeds, reinforcing rings provide necessary wheel rigidity.

BEARINGS — Self-aligning anti-friction bearings are designed for continuous operation at maximum tip speed. Horizontally split, ring-oiled, self-aligning, babbitted sleeve bearings are also available.

For full details, contact your "Buffalo" representative, or write for Bulletins F-102 and F-200.

Minimum maintenance is assured by the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life in every "Buffalo" product.

"Buffalo"

BUFFALO FORGE COMPANY

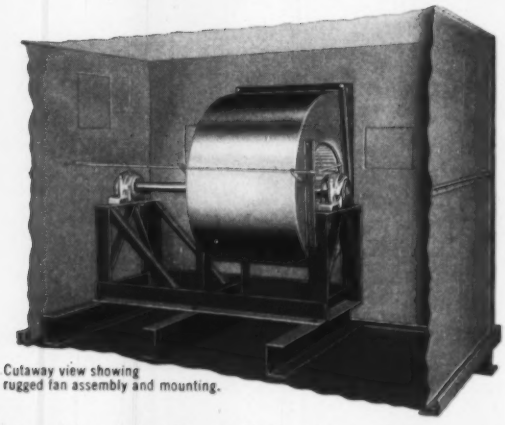
148 Mortimer Street • Buffalo, N. Y.

BUFFALO PUMPS DIVISION, BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

A new pace-setter



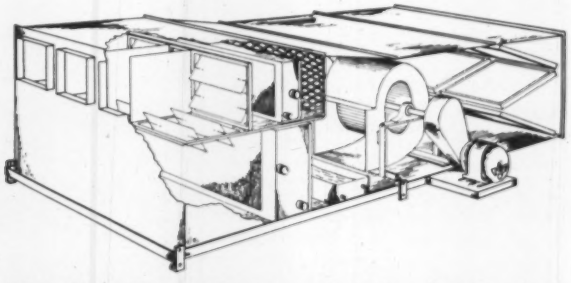
Cutaway view showing rugged fan assembly and mounting.

Clarage Hi-Static Multitherm for High Velocity Air Conditioning Systems

INTRODUCED IN 1955 by Clarage, this new line of Draw-Thru type units fully answers the requirements of conduit type systems where high duct velocities and pressures to 8" static are involved.

FIRST INSTALLED IN 1956 in the Pennsylvania Lumbermen's Mutual Insurance Building, Philadelphia. Since then numerous Clarage Hi-Static Multitherms have been specified and used because of stable, efficient operation. Request Bulletin 1312 covering the 7 sizes, capacities 2,500 to 22,000 CFM.

Still a pace-setter



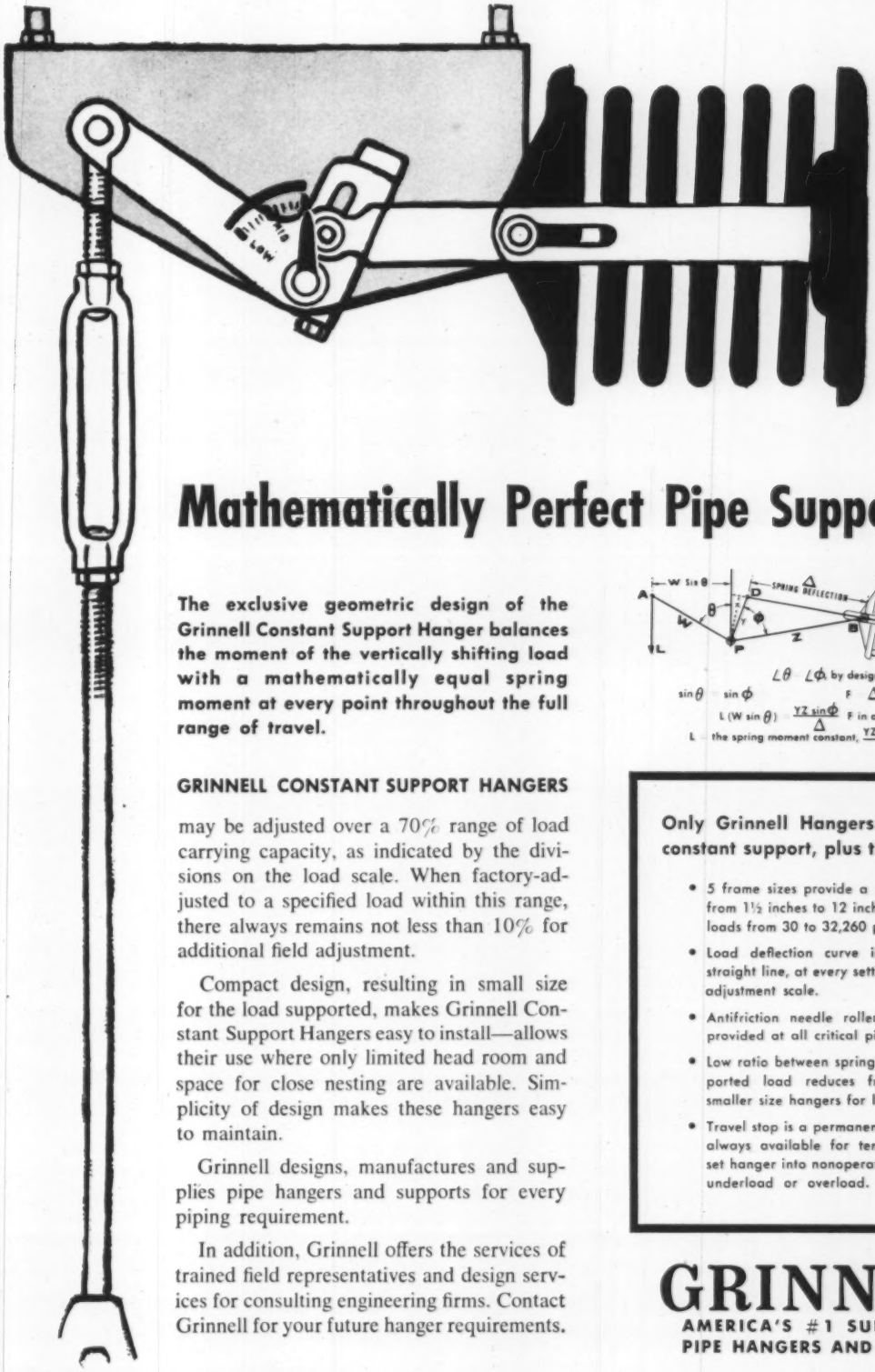
Clarage Blow-Thru Multitherm for Central Station Zone Control Air Conditioning

INTRODUCED IN 1939 by Clarage, the pioneer and perfecter of this type of equipment. A single Blow-Thru Multitherm Unit can handle as many as 8 different zones for different area requirements.

FIRST INSTALLED IN 1940 in the Northern Indiana Brass Co. office building, Elkhart. Over 1000 Clarage Blow-Thru Multitherms have now been installed the nation over—selected because of their unique feature of *mixing* hot and cold air to prevent stratification... their quiet, economical, dependable performance. Request Bulletin 1310 covering the 12 sizes, capacities to 12,000 CFM.

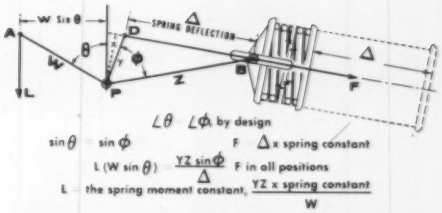
CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



Mathematically Perfect Pipe Support!

The exclusive geometric design of the Grinnell Constant Support Hanger balances the moment of the vertically shifting load with a mathematically equal spring moment at every point throughout the full range of travel.



GRINNELL CONSTANT SUPPORT HANGERS

may be adjusted over a 70% range of load carrying capacity, as indicated by the divisions on the load scale. When factory-adjusted to a specified load within this range, there always remains not less than 10% for additional field adjustment.

Compact design, resulting in small size for the load supported, makes Grinnell Constant Support Hangers easy to install—allows their use where only limited head room and space for close nesting are available. Simplicity of design makes these hangers easy to maintain.

Grinnell designs, manufactures and supplies pipe hangers and supports for every piping requirement.

In addition, Grinnell offers the services of trained field representatives and design services for consulting engineering firms. Contact Grinnell for your future hanger requirements.

Only Grinnell Hangers provide true constant support, plus these features:

- 5 frame sizes provide a range of travel from 1½ inches to 12 inches and support loads from 30 to 32,260 pounds.
- Load deflection curve is a horizontal straight line, at every setting on the load adjustment scale.
- Antifriction needle roller bearings are provided at all critical pivot points.
- Low ratio between spring force and supported load reduces friction, permits smaller size hangers for loads carried.
- Travel stop is a permanent attachment — always available for temporary use to set hanger into nonoperative position for underload or overload.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

NOTABLE ACHIEVEMENTS AT JPL . . .

THE ARMY'S NEW SERGEANT

JPL is proud to have the responsibility of designing and developing the U.S. Army's newest operational missile system—the Sergeant. This weapon is America's first truly "second generation" surface-to-surface tactical missile and, when placed in production will eventually succeed the Corporal which was also a JPL development.

The Sergeant, especially designed as an extremely mobile tactical weapon, utilizes a solid propellant rocket motor which provides better field handling and storage capabilities than those of many other weapon systems. It can deliver a nuclear blow deep into enemy territory and its highly accurate guidance system is invulnerable to any known means of enemy countermeasure.

All elements of the Sergeant are particularly designed for active field use with emphasis on reliability, mobility and the use of standard U.S. Army vehicles wherever possible. The erector-launcher, for example, is capable of rapid movement over rough terrain. These characteristics place in the hands of the U.S. Army an important new tactical element of extended range.

The basic activity at JPL continues to be—research into all scientific fields related to the development of weapons systems and space research vehicles.

CAREER OPPORTUNITIES NOW OPEN IN THESE FIELDS

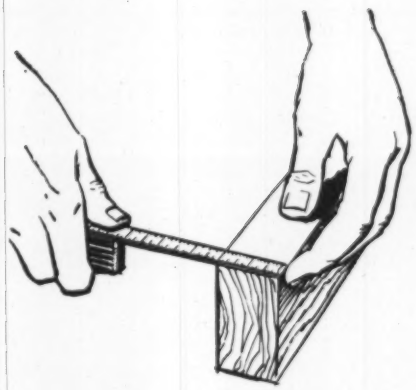
ELECTRONIC, MECHANICAL, CHEMICAL AND AERONAUTICAL ENGINEERING • PHYSICS AND MATHEMATICS

jpl

JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA • CALIFORNIA



Measure COOLING TOWER LIFE with a RULER?

YES! DIMENSION and QUALITY of redwood are the obvious and fundamental cornerstones on which long service life and low maintenance costs must rest. They are your ONLY protection against delignification or chemical attack! Coupled with proper wood preserving treatment, they provide the necessary safeguards even in those areas where biological attack is prevalent.

COMPARE WHEN YOU BUY — AND INSIST ON GETTING THESE FOSTER WHEELER STANDARDS

THICKNESS COMPARISON OF IMPORTANT TOWER COMPONENTS

TOWER COMPONENTS	FOSTER WHEELER	MANUFACTURER "A"	MANUFACTURER "B"
SPLASH BARS	1"	1"	3/8"
FILL DECK SUPPORTS	2"	1"	1/2"
WATER DISTRIBUTION SYSTEM	2"	1"	1"
FAN STACK SHEATHING	1 1/2"	1"	3/8"
AIR INLET LOUVERS	1"	1/2"	1/2"
DRIFT ELIMINATOR BLADES	9/16"	7/16"	5/16"

"To conserve water is good business . . . for you, your neighbor, and the Nation."

FOUNDER MEMBER CTI COOLING TOWER INSTITUTE

FOSTER WHEELER

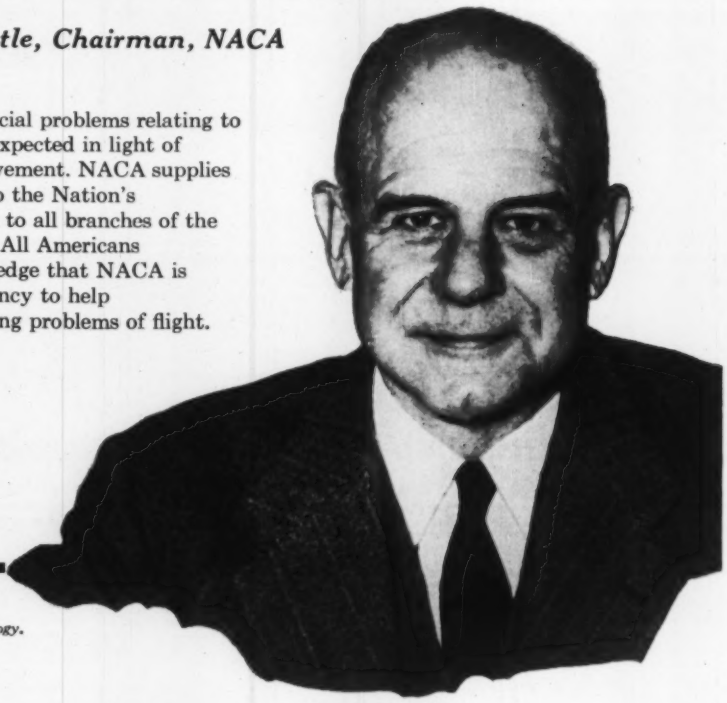
NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

A message for young physical scientists & engineers

from James H. Doolittle, Chairman, NACA

Future breakthroughs on crucial problems relating to aircraft and missiles can be expected in light of NACA's long record of achievement. NACA supplies advanced research findings to the Nation's aircraft and missile industry, to all branches of the military, and to the airlines. All Americans can be assured by the knowledge that NACA is working with a spirit of urgency to help solve the current most pressing problems of flight.

James H. Doolittle



James H. Doolittle, Chairman, NACA;
Sc.D., Massachusetts Institute of Technology.

NACA has a staff of 7,750 research scientists and supporting personnel spread among centers on both Coasts and in Ohio. NACA staff members in pursuit of new knowledge have available the finest research facilities in the world, including several of the largest and fastest supersonic and hypersonic wind tunnels, hot jets, a fleet of full scale research airplanes, which will include the X-15, hypersonic ballistics ranges, shock tubes, a nuclear reactor establishment, rocket facilities, a research missile launching site, tracking devices, and the most advanced mechanical and electronic computers.

NACA Fields of Research Include: Aerodynamics, Aircraft and Missile Structures, Materials for Aircraft and Missiles, Automatic Stabilization, Propulsion Systems, Propulsion Systems Structures, Rocket Systems, Solid State Physics, Fuels, Instrumentation.

A number of staff openings are becoming available. You are invited to address an inquiry to the Personnel Director at any one or all four of the NACA research centers:

Langley Aeronautical Laboratory, Hampton, Virginia
Ames Aeronautical Laboratory, Mountain View, California
Lewis Flight Propulsion Laboratory, Cleveland, Ohio
High-Speed Flight Station, Edwards, California

(Positions are filled in accordance with the Aeronautical Research Scientist Announcement 1B)

NACA

The Nation's Aeronautical Research Establishment

compact, efficient, mass produced for quick delivery

a new P-K product line you'll want to know about– and the new P-K catalog that describes it

–YOURS FOR THE ASKING!

The P-K Type DW convertor and water heater is for use below the water line of steam or hot water boilers. It is engineered for high heat transfer and low maintenance and the design is standardized for a complete selection of sizes – capacities – temperature ranges – for industrial and domestic "water to water" heat applications.

Mail the coupon now for complete description, including capacity and dimensional tables of sizes available for fast delivery. The Patterson-Kelley Co., Inc., 2405 Warren St., East Stroudsburg, Penna.

Patterson-Kelley Co., Inc.
2405 Warren St., East Stroudsburg, Penna.
Send me a copy of Bulletin No. 6050 on the new P-K Type DW convertor and water heater.

*Name*_____ *Title*_____

*Company*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

Patterson Kelley

Water Heater Division

Storage Water Heaters • Instantaneous Heaters Convertors • Fuel Oil Heaters

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

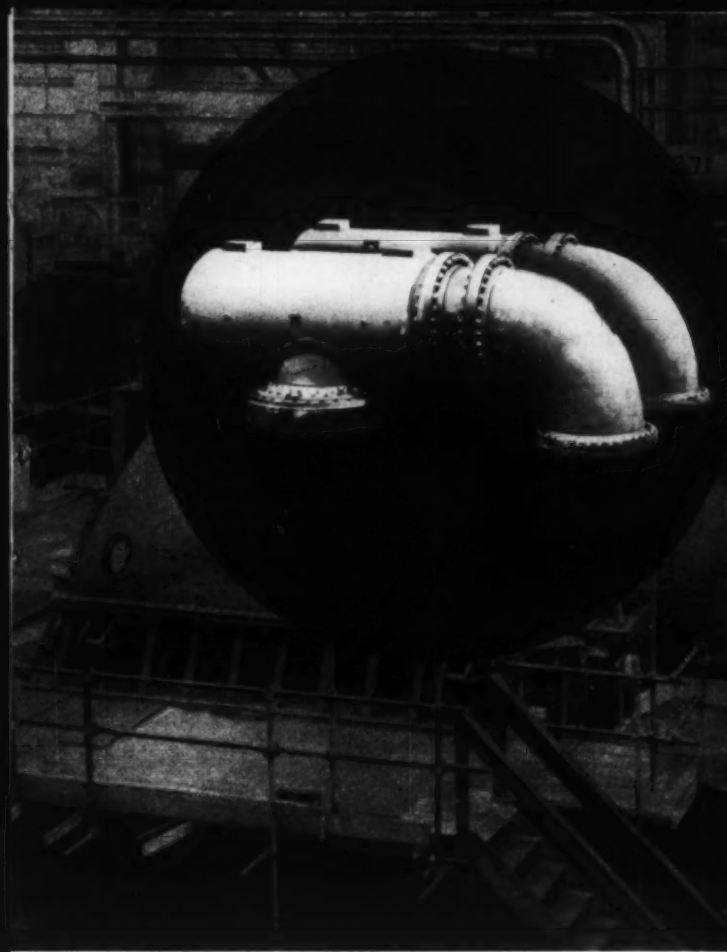
President, Douglas Aircraft Co., Inc.

Here at Douglas we're involved in a greatly accelerated missile and space program. This requires one of the most intensive engineering and research efforts in our history.

The problems are great ones as we move into the new dimension of unmanned and manned space vehicles. They require specialists in almost every engineering field. But their solution will result in great benefits not only to our own nation but to all mankind.

If you're interested in tackling these problems with us... in giving your best in an all-out drive to solve them... we're interested in you!

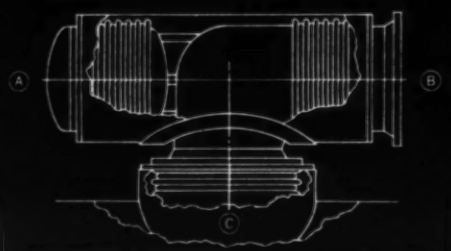
Please write to Mr. C. C. La Vene
Douglas Aircraft Company, Box K-620
Santa Monica, California



GIANT Turbine Expansion Joints Built by BADGER

Photo shows 150,000 kw steam turbine-generator unit undergoing tests prior to shipment at General Electric's Turbine-Generator Plant in Schenectady, N. Y. Badger Expansion Assembly is clearly visible atop turbine.

Badger balanced elbow expansion assembly.



Joint A balances thrust due to internal pressure of 65-150 psi; joint B absorbs axial movement; joint C absorbs the differential expansion between the inner and outer casings of the turbine. Assemblies range in size from 36 to 42 inches in diameter.

Custom engineered assemblies include many features of Badger S-R Design

750°F steam is flashed through these turbine crossovers at speeds up to 150 ft/sec and pressures up to 150 psi.

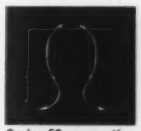
How do you protect piping and turbine casings from the stresses of extreme internal pressure and the expansion such temperature is bound to produce?

Working together, Badger and engineers at General Electric's Large Steam Turbine-Generator Department solved the problem with a new type pressure balanced elbow expansion assembly. Using two separate joints mounted in a T-shape casing (see diagram) the assembly effectively absorbs and controls axial movement. Although the device was custom engineered to General Electric's requirements, the bellows elements are constructed to the Curvilinear Corrugation design recently announced by Badger and now used in all S-R Expansion Joints.

Whether you need standard S-R Expansion Joints or custom equipment, Badger can serve your needs. Get more information — write for illustrated brochure today.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced... life increased.



Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.

Series 150 corrugation and ring cross-section

BADGER

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scientists and engineers

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ANALYZE	Degree essential. Experience as required. **Preliminary analysis:** Conduct preliminary analysis and design of overall power reactor systems and components. **Shielding analysis:** Advanced studies and analysis on stationary and mobile plants. **Systems analysis:** Engineering direction on reactor plant design. **Control analysis:** Reactor kinetic and overall nuclear power plant control. Hazard analysis. Analog and digital computers. **Core analysis:** Includes criticality, temperature, void and power coefficients, control effectiveness and fuel cycles. **Stress analysis:** Structural, thermal, and dynamic stress analysis of high temperature reactor systems. **Heat transfer analysis:** Reactor systems—dynamics and thermo-dynamics of fluid flow. **Operations:** Foreign and domestic—for checkout, start-up and training.
DEVELOP	Requires related experience and applicable degree. **Instrumentation and control:** Physicists and EE's for design and development of advanced design vacuum tube, transistor, and/or magnetic amplifier control and instrumentation components. Design and analysis on reactor control systems, using stability and transient response techniques. **Fuel elements:** Metallurgists for R&D on nuclear fuel materials, including radiation effects, evaluation of uranium and thorium alloy, and ceramics. Also for mechanical fabrication development for these materials. **Nuclear fuel reprocessing:** Inorganic and physical chemists for developmental studies and experimental work. Experience with radio-active materials and high temperature processes desirable.
DESIGN	Senior openings. Degree required. Nuclear experience preferred but not essential. **Control mechanisms:** Control and safety rods, drives and allied tooling. **Reactor core components:** Moderator cans, fuel elements, core supporting structures. **Machine design:** Heavy mechanical. **Electrical:** Reactor control and power systems. **Process systems and equipment:** Pumps, Heat transfer equipment. **Facilities:** Mechanical systems. **Process instrumentation:** Reactor, auxiliary, and control systems.

Other opportunities in:
Theoretical, Experimental, Solid State Physics, Health Physics, Materials Research, Mechanical Component Development.

New programs add to years-ahead backlog

Atomics International has built and is operating two power reactors—the Sodium Reactor Experiment and the Organic Moderated Reactor Experiment. Central station power plants based on these reactor concepts are in the planning stages right now. In addition, AI has just begun an advanced power reactor study for Southwest Atomic Energy Associates, a group of 15 investor-owned utility companies.

AI is expanding overseas operations. With 5 foreign reactors already in operation or being built, AI recently signed agreements with ASEA of Sweden, which has offices in 50 countries, and DEMAG of West Germany, with whom AI formed the new company, INTERATOM, in Duisburg, West Germany.

Write today for more details about exciting career opportunities at AI.

Mr. A. E. Newton, Personnel Office, Atomics International
15330 Raymer Street, Van Nuys, California
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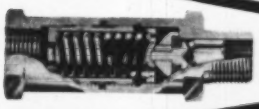

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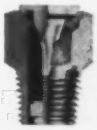

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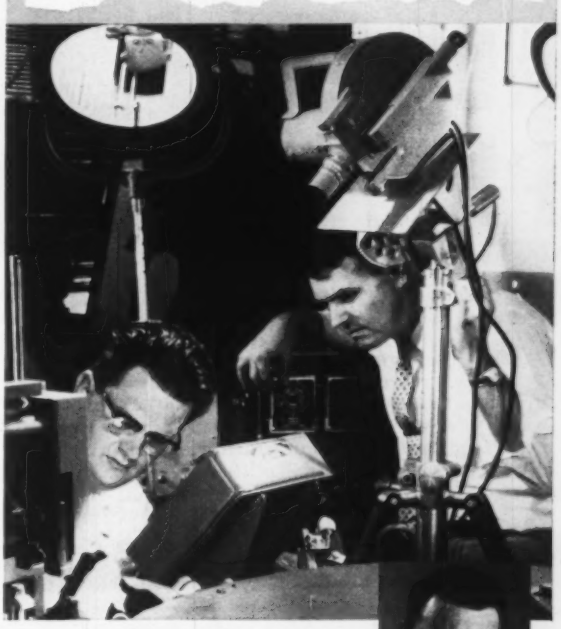

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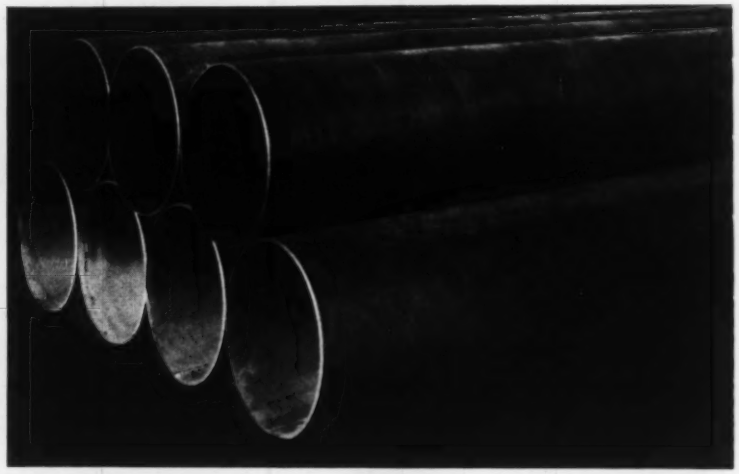

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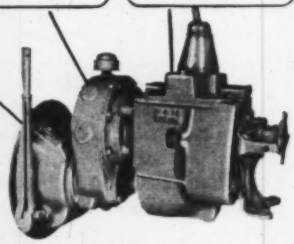

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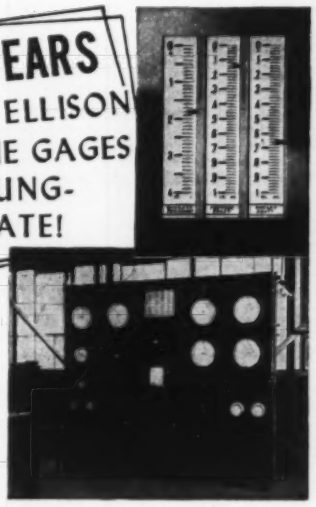

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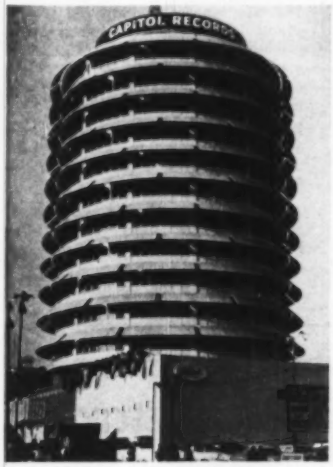

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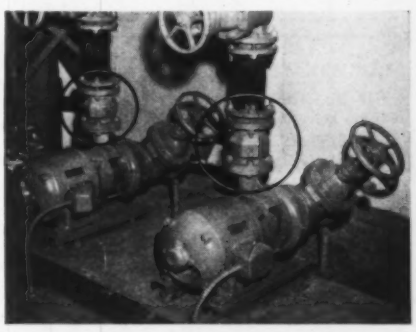

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Page reserved for advertisements to experienced engineering specialists to fill immediate openings.

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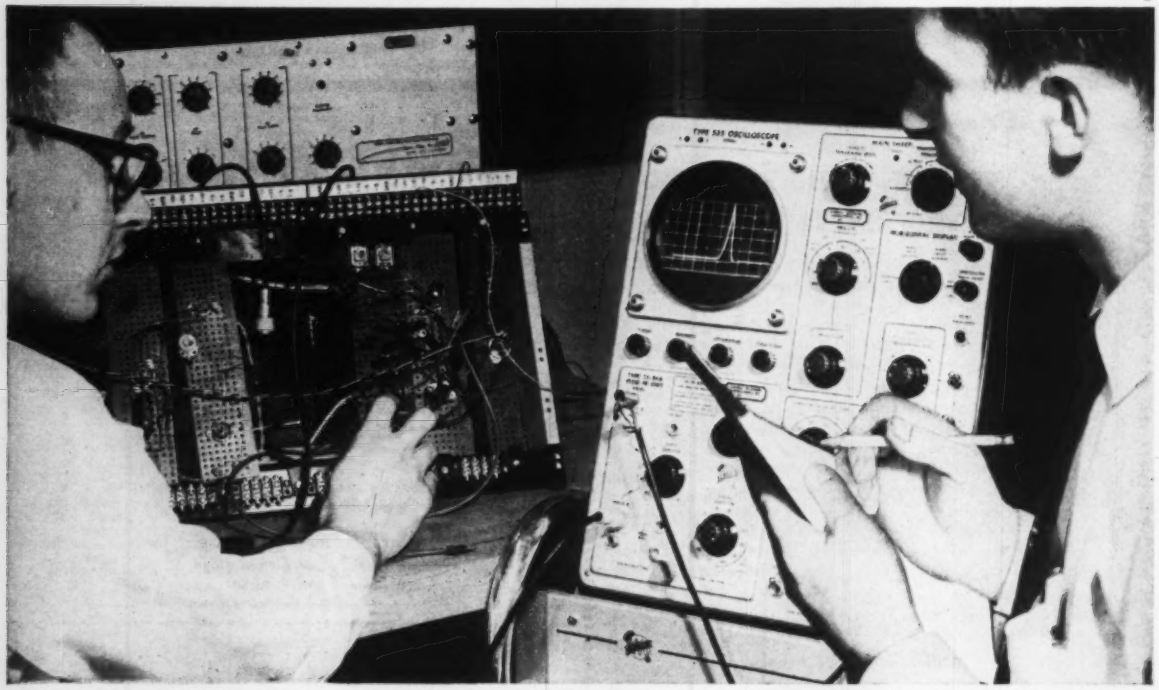

General Telephone engineers using a "535" oscilloscope to check high-speed circuitry.

We're applying high-frequency pulse techniques to telephones of the future

IN DESIGNING tomorrow's telephone systems, General Telephone Laboratories is applying electronics to provide new standards of service.

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As applied in telephony, multiplexing works like this: The speech paths of a person talking on the phone are first reduced to pulses. A single word then consists of millions of pulses. These pulses are released to the line at regular intervals by the opening and closing of a gate switch. Pulses are stored for microsecond intervals between releases.

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■

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Discussing characteristics of the capacitor system are research scientist Dr. Edward Fisher of the Propulsion Staff, right, and Dr. Terry E. Turner, Hot Shot Tunnel Group Leader. The two groups are engaged in a joint effort on advanced propulsion experiments.

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Excellent opportunity for thermodynamics engineer with extensive experience in aircraft installation and cooling work. Should have good background in heat transfer, packaging and aircraft structures.

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Military Products Div.
IBM Corporation
Owego, New York

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Apply—FEDERAL PACIFIC ELECTRIC CO.
5815 Third Street San Francisco, Calif.

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Work consists of translating process requirements into completed operating pilot plants and includes mechanical design, proper application of equipment, instrumentation, cost estimation, scheduling, materials procurement, field supervision of construction, initial operating shake-down, and new equipment development.

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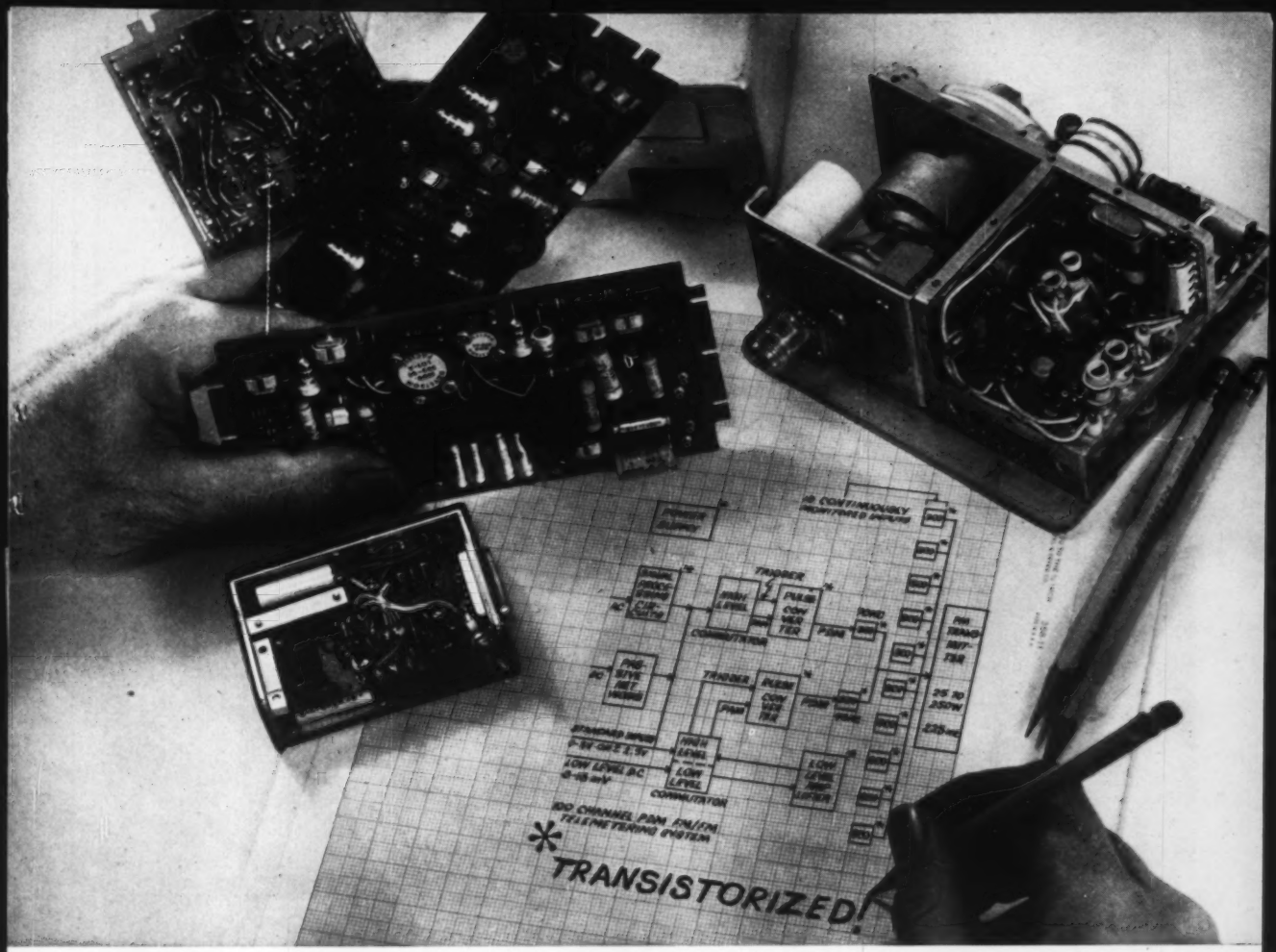

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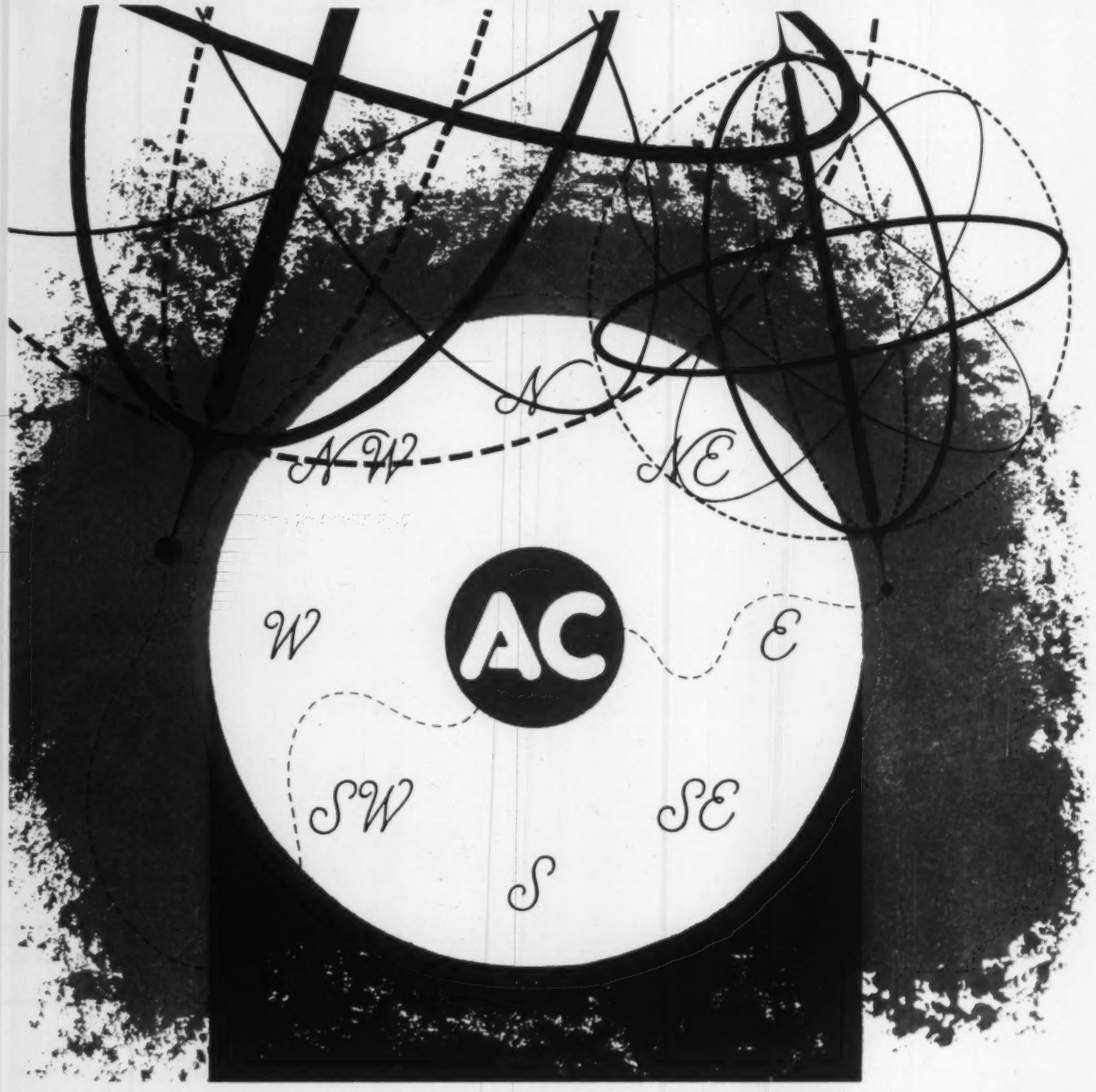

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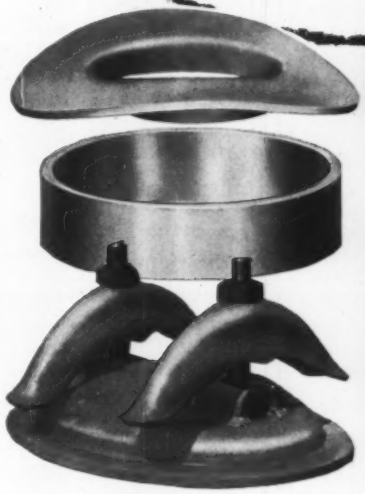

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See our standard line of pressure vessel connections on pages 1128-1129 in the 1958 Chemical Engineering Catalog.

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LENAPE HYDRAULIC PRESSING & FORGING CO.
DEPT. 114 WEST CHESTER, PA.
RED MAN PRODUCTS

Linkage

The Long and Short of it . . .

HEIM *Unibal* Rod Ends

make an Infinitely Adjustable Linkage

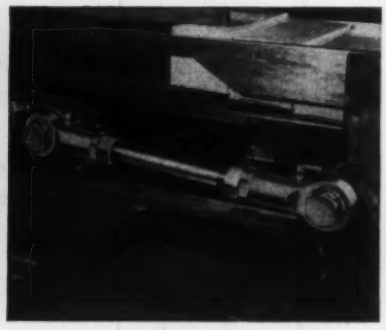
For a short connecting rod, an externally threaded male Heim rod end can be screwed into an internally threaded female rod end to give smooth transmission of power or force.

Longer connecting rod assemblies are just as simple to make by using the proper length of tube or rod between Heim rod ends.

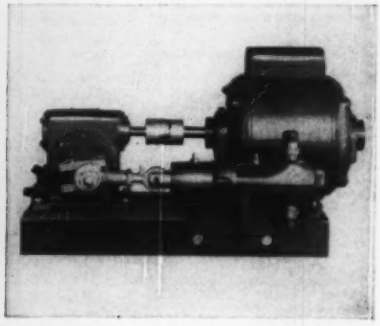
The push-pull rods or linkages can be assembled by riveting, by swaging, by welding, or by threading and locking with set screws or lock nuts.

Heim Unibal Rod Ends are self-aligning, they reduce friction and lost motion, and they are economical in price and in installation time.

A short length of rod, threaded at both ends to fit two Heim Unibal female rod ends, is used on this Foster Machine Co. Model 75 pineapple coning machine. This machine is used for winding nylon, and rayon yarns to packages for use on full fashion knitting machines.



A longer length of rod, with two Heim Rod Ends locked in position with hex nuts, actuates the feed on this cartoner made by R. A. Jones & Co. Jones Constant Motion Cartoners handle millions of bottles, jars, tubes, etc. every day in a wide variety of packaging.

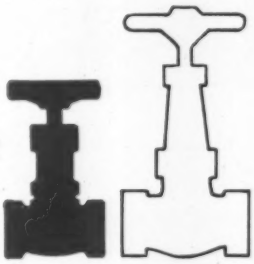


A male Heim rod end screwed into a female rod end forms the short linkage necessary on this Milton Roy pump. The self-aligning feature of Heim Unibal corrects the misalignment between the crank arm and the plunger moving in the pump frame.

The Heim engineering department will be glad to assist in solving your linkage problems. The Heim catalog should be at your fingertips. Please write.

THE HEIM COMPANY / Fairfield, Connecticut

See How **LUNKENHEIMER** SPACE-SAVING NEEDLE VALVES *Cut Maintenance*

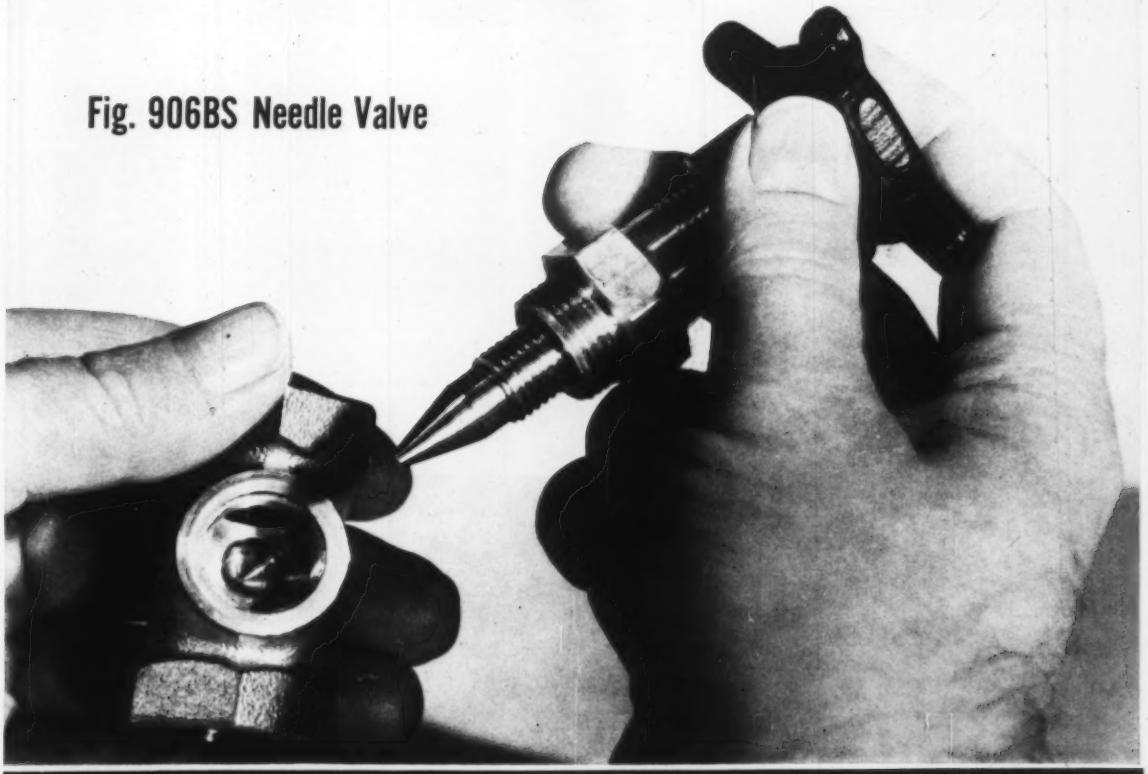


Precision machining . . . compact design . . . meticulous workmanship. You see them all in this unretouched photograph. And what you see means only one thing—quality—the kind of quality that keeps maintenance costs down.

The evidence is even easier to see when you compare the Lunkenheimer Needle Valve—part-for-part check for modern compact design—with any other valve you can buy. Let your Lunkenheimer Distributor show you what we mean.

Feature-for-feature, he will match the Lunkenheimer Needle Valve against any needle valve you have in stock. But don't buy on sight alone. Make an on-the-line comparison test. Let your maintenance savings prove why it pays to standardize on Lunkenheimer Needle Valves . . . or write The Lunkenheimer Company, Cincinnati 14, Ohio.

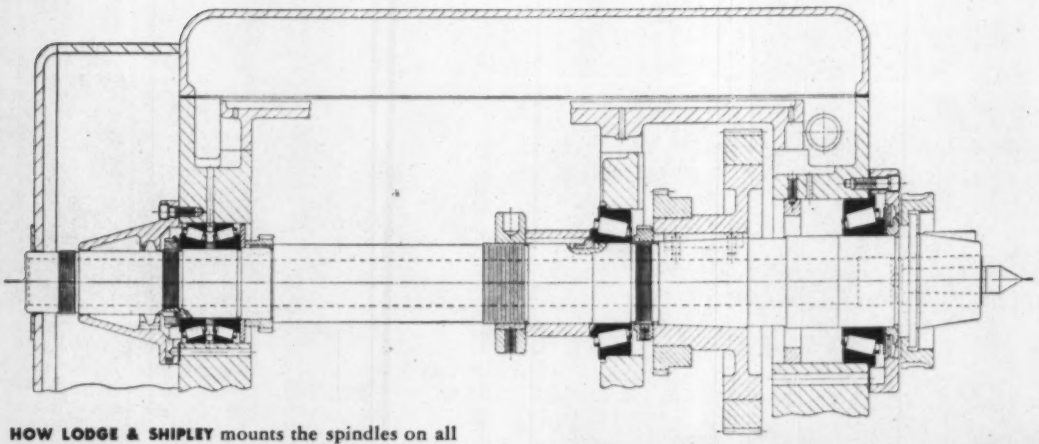
Fig. 906BS Needle Valve



LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES



HOW LODGE & SHIPLEY mounts the spindles on all 2013 Powerturn lathes including both 45° and 90° Copymatics on Timken bearings to get extra rigidity, maintain accuracy, reduce maintenance.

New type lathe ups production 200%, saves users an estimated $8,000 a year

...one secret—TIMKEN® bearings on the spindle

"Production increases as high as 200%"..."Overall savings estimated at $8,000 a year"—read user reports about the new 2013 Powerturn 90° Copymatic Lathe. One important reason for such exceptional results is that Lodge & Shipley mounts the spindle on Timken® tapered roller bearings. Timken bearings give it the vital extra rigidity and hold runout to the minimum needed for tracer accuracy.

How spindle is held rigid. Timken bearings hold the spindle in positive alignment. They take *both* radial and thrust loads in any combination, because of their tapered design. And because of full line contact between rollers and races, Timken bearings have extra load-carrying capacity.

Why heavy shocks are absorbed. Case-carburization of Timken bearings' rollers and races gives them hard, wear-resistant surfaces and tough, shock-resistant cores.

How friction is virtually eliminated. Timken bearings are geometrically designed to roll true. And they're precision-made to live up to their design. They run smoother—last longer.

We even make our own electric furnace fine alloy steel, for extra quality control. We're America's only bearing maker that does. To get all these advantages, always specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN TAPERED ROLLER BEARINGS ROLL THE LOAD

TRADE-MARK REG. U. S. PAT. OFF.